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JANUARY TO DECEMBER,
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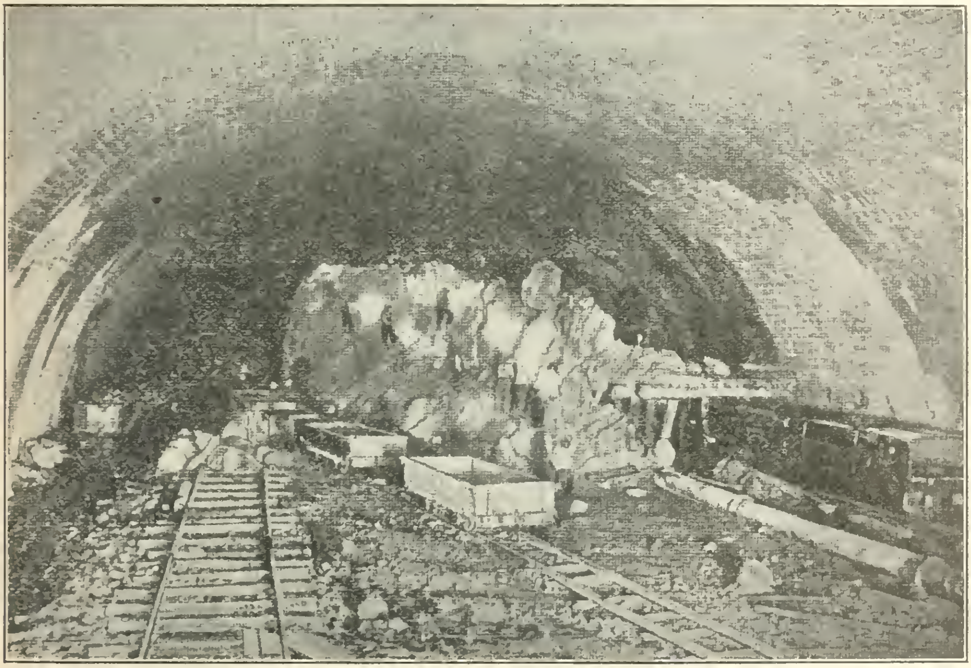

CUTTING OUT THE CORE OF THE BIG TUNNEL.

LATEST AND GREATEST WORLD TUNNEL

The tunnel interior here shown tells its own story most impressively. The work shown is in France where while the greatest war of the ages is taxing the nation's resources to the uttermost the obligation of providing for its future life and growth is still imperative. More than a dozen years ago the plans became operative for a canal to connect the important seaport of Marseilles with the river Rhone and the existing system of interior waterways, and the work has been carried on notwithstanding the exigent war conditions.

The total length of the canal is 51 miles and its water section is 82 feet wide and 10 feet deep, with wide tow-paths on each side. The most exacting engineering feature is the tunnel, the necessity of building which long held back the entire enterprise. This tunnel which is now within sight of completion is in more than one particular the greatest yet undertaken in the world. It is 4½ miles long, which makes it the longest in France, but its sectional area is about ten times that of an ordinary railroad tunnel while the rock to be removed is some 50 per cent. more than that taken from the two Simplan tunnels and very nearly double that from the St. Gothard.

The tunnel section may be conveniently described as a horizontal rectangle upon which is superimposed a circular segment, giving an extreme width of 79 feet, a height of 50 ft. and a section of 3,250 sq. ft. The tunnel construction, which was through sound, hard rock, requiring little timbering, was carried on from three arch headings of about 100 sq. ft. area which were then opened into each other, leaving a large central section to be removed later.

The lining of the tunnel is of masonry backed on concrete, which is made of a special lime and not from the usual Portland cement. The retention of the central mass until the last made it easy and profitable to do all the lining without the erection of high and expensive scaffolding. The half tone shows the lining completed and the removal of the core in progress, this operation being similar to any out of door rock work. It will be seen that the latest type of hand-held, one-man drills are employed. The trains for removing the spoil are drawn by compressed air locomotives in the headings and by steam in the open section. The "holing through" of the tunnel was celebrated on May 6 of last year and was spoken of in the August issue of Compressed Air Magazine. It is understood that two or three years will still be required for the completion of the entire work.

An indication of the widespread interest in engineering circles as to our future commercial and engineering relations with South American countries is given by the fact that 180 out of 231 students entering Stevens Institute of Technology this fall have elected to study Spanish instead of French or German. This is a remarkable increase in proportion over other years at Stevens in favor of Spanish. Every student entering Stevens is required to study one foreign language during the first two years of his course, and is allowed to choose either advanced French or German or beginner's Spanish.

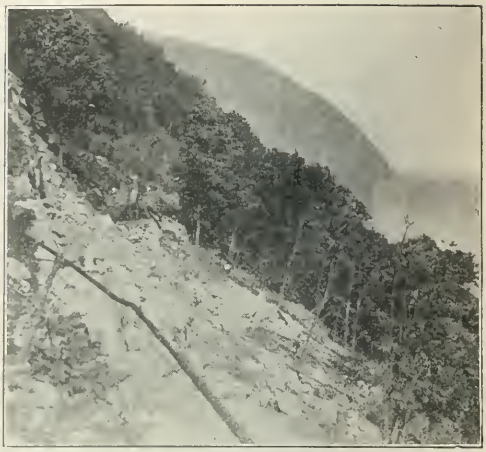

FIG. I. ON CROW NEST MOUNTAIN.

ROCK WORK ON STORM KING HIGHWAY

BY H. L. HICKS

Construction work is being pushed on the Storm King Road, the final link in the New York State Highway between New York and Albany. It extends a distance of 4¼ miles between West Point and Cornwall, N. Y. For practically the entire distance the road is a side hill cut around Crow Nest and Storm King Mountains. It directly overlooks the Hudson River and reaches at its highest point an elevation of 400 ft. above sea level.

The mountain sides are very steep and inaccessible and road building presents many difficulties. The excavation work required totals 60,000 cu. yd. of rock and 80,000 cu. yd. of earth and boulders. The rock is a bastard granite and the boulders vary in size up to 250 cu. yd. There are seven gangs at work in four different places, making the cut and building the retaining wall. This is from 10 to 50 ft. in height, from 3 to 8 ft. being laid in mortar and the balance dry masonry, completed by a rustic stone parapet. Stones for the wall are placed by four hoists and two cranes. The balance of the handling and hauling is done by hand and, at one working, by mules.

JACKHAMERS

Drilling for excavation and for anchoring the retaining walls is done by Jackhamers, of which there are 12 in use. These hand drills are giving a good account of themselves al-

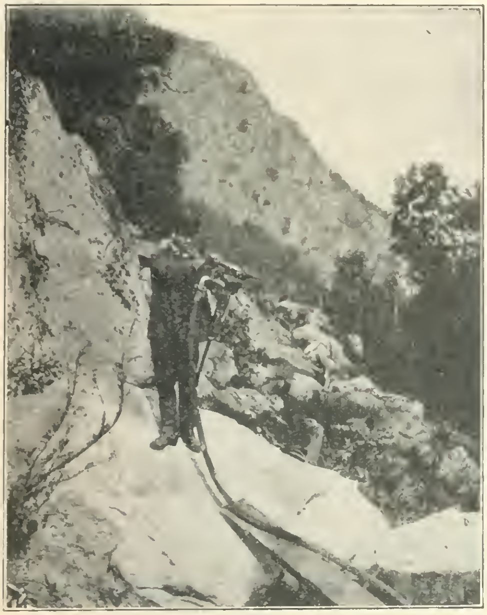

FIG. 2. AWKWARD JACKHAMER DRILLING.

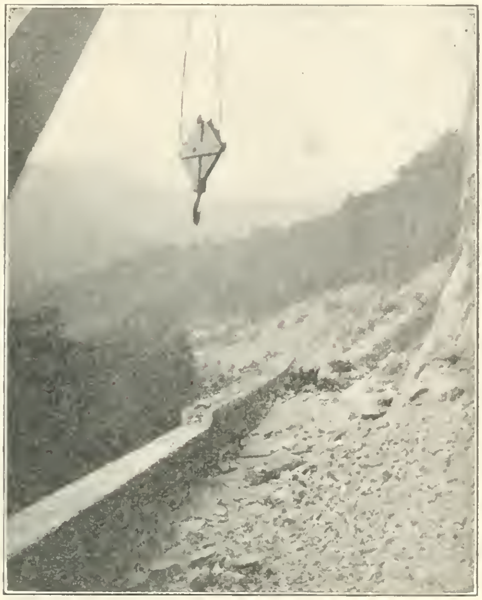

FIG. 3. ROUGH GRADED ROADWAY.

though the duty is a severe one. Much of the work is done in places and at angles which make it impossible for the drill runner to properly hold his machine. In fact, it is quite common for the drill to support the man instead of the man holding the drill. In drilling the cliff at Storm King, where the cut rose a sheer 150 ft. above the road bed, the workmen drilled while suspended in a harness of heavy canvas bands. Unfortunately for the contractor this portion of the work was brought to a standstill at a time when the Jackhamer operators had been working in mid-air long enough to have become accustomed to it and to have reached their maximum efficiency. A stone company, whose unused crusher plant, lying at the foot of the cliff was damaged by falling rock, obtained an injunction indefinitely halting work at this place.

Cross bits are used at all workings. Sharpening is done both by hand and by a Leyner sharpener. The latter is mounted on the edge of the cliff with scant protection from the elements. It is used for shanking as well as sharpening. Air for operating the Jackhamers and hoists at all workings is piped from a plant at the Cornwall end of the contract. This air compressing plant, a 1,400 cu. ft. Imperial short belt, electric motor driven machine, was purchased, as it stands from the Oscar Daniels Co., who had recently completed the Moodna Siphon of the Catskill Aqueduct. The air line follows the track of the West Shore R. R. at the foot of the mountains. There is 500 ft.

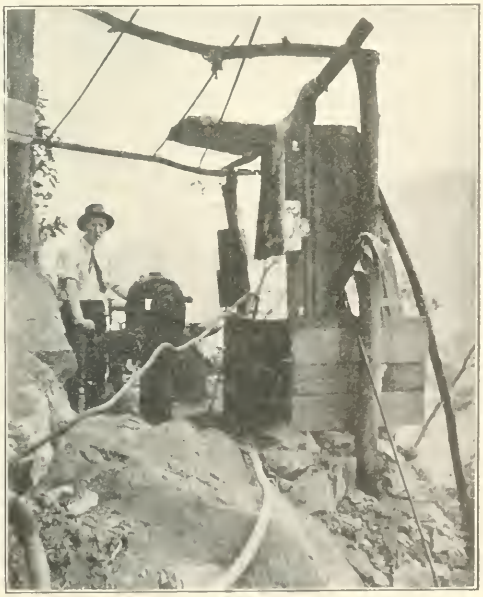

FIG. 4. LEYNER DRILL SHARPENER ON EDGE OF CLIFF.

of 6-in., 300 ft. of 4-in. piping, the balance being of 2-in. diameter. All branches from this main air line to the working places are of 2-in. pipe.

Considerable trouble is experienced from rock falling on the railroad tracks. The contractor maintains a locomotive crane on a siding at the foot of each mountain, although the rock that comes down is usually small enough to be removed by hand. At the time the writer's visit a flying fragment, striking a telegraph pole, broke it in half. At other times rails have been broken.

The John L. Hayes Construction Co. of Cornwall, N. Y., is building this road under the personal direction of Mr. John L. Hayes. Mr. A. C. Perkins is superintendent, assisted by Mr. J. J. O'Neill.

THE ENGINEER SAVES THE MACARONI

In the following interesting narrative which we reproduce from a recent issue of *Saturday Evening Post* it is to be noted that while the chemical engineer is spoken of all through the article there was really no chemistry involved in the solution, although it may have entered into the preliminary investigations. Success came with the proper adjustment of the temperature and humidity of the air and its proper circulation.

Two young Italians, who had worked in a small but successful macaroni factory in the East, started an enterprise of this kind in a Western city. Their drier was an exact reproduction of the one in the plant where they had worked. The product of their little factory was entirely acceptable to their market; and, as both these young Neapolitans were hustlers and were well located, their business grew in the course of a few years to a point where they faced the necessity of providing a much larger output. Consequently they built an addition to their factory and installed a drier of large capacity, calculated to take care of all the expansion they could reasonably expect in the next few years. The new drier was modeled after the one that had given them such satisfactory service from the very beginning of their business.

Probably one of the greatest strains to which the true Neapolitan temperament was ever subjected was exerted when the two partners made the discovery that the product of their new drier was so far inferior to that of the old one as to spell failure for them unless the trouble could be corrected. Instead of being hard and brittle, and breaking with a long fracture, the tubes of macaroni from the new drier were green and semi-elastic, with the result that they were both unacceptable for immediate use and were prone to mold and spoil.

One alteration after another was made in the equipment of the new drier, but without producing any marked improvement in the product. This period of hit-or-miss experiment extended over several months, the proprietors growing more desperate with every passing week.

Finally they took one of their most intelligent customers into their confidence and he advised them to consult a leading chemical engineer, whose laboratories were located in Chicago. He warned them that probably the fee would not be small and that satisfactory results could not be guaranteed. As it was clear to them that they were facing financial ruin, they decided to accept the alternative, take the chances, and see what laboratory science could do for a macaroni drier and its product.

The chemical engineer first satisfied himself that the failure of the product was not due to any defect in the materials used—which were found to be of the highest quality—but that the fault must lie in the curing alone.

A CLIMATE TO ORDER

He then defined his problem by saying that it was up to him to create, inside of that drier, an ideal Italian climate which could be relied upon to remain the same day after day. This he finally succeeded in doing, securing a combination of heat, humidity and air velocity that was practically "foolproof," and that cured the macaroni as perfectly as if it was dried in the sunshine and breezes of Italy.

Naturally any attempt to convince these two Neapolitans that industrial chemistry is either impractical or too expensive an aid for the small manufacturer would be so much wasted breath. They look upon the laboratory of the consulting chemist to whom they appealed for help very much as a rescued seaman might look upon the life-saving station whose crew had saved him when he seemed ready to sink.

A man in Canada traveled from Dundas to Niagara Falls, 125 miles, on four gallons of gasoline—31 miles per gallon—in a Gray-Dort 4-cyl. car.

AIR DELIVERY FACTORS OF BLOWING ENGINES

BY W. TRINKS

Whenever the air delivery as determined by the indicator card is compared to the air as computed from the chemical reactions in the blast furnace, or to the quantity found from a careful test, a discrepancy is discovered. The actual air delivery is always smaller than that computed from the indicator card. The reasons for this difference are heat interchange, and leakage. During compression, air heats the walls of the air tub. During suction, the walls heat the incoming air to an unknown temperature. The air tub is, therefore, filled to an extent indicated by the card, but with air of smaller density, the unknown reduction of density corresponding to the unknown rise of temperature. However, the change of density varies within certain limits which are well known from tests, and is not responsible for the great reduction of air delivery shown by old and worn-out engines. In the latter cases leakage plays an important part. Leakage through the inlet valves is a direct loss of air delivery. It can be heard, and is usually attended to for that reason. Leakage past the piston and back through the discharge valves causes not only direct losses in air delivery, but also indirect losses. Air heated by compression and slipping back to the inlet retains its high temperature while slipping back, and is raised to a much higher temperature during re-compression. The cylinder walls assume a much higher temperature, and what little air comes in is still further reduced in density.

The problem of determining the air delivery from the indicator card with a fair degree of accuracy then resolves itself into these two problems: First to eliminate leakage, second, to determine the factor for the reduction of density.

As before mentioned, leakage of the inlet valves can plainly be heard and is, therefore, eliminated, except in sadly neglected furnace plants, where nobody cares what the air delivery is. Leakage past the piston and through the discharge valves is not so easily found, unless the engine is equipped for discovering it. With equipment, its detection offers no difficulties. In Fig. 1, with valves B and C open, leakage of the upper discharge valves can be tested; with valves E and F open, that of the lower discharge valves can be tested. With A and B, and E and F open, C and D closed, leakage past the piston is discovered. Indicator openings now serve the same purpose to a limited extent, but only very incompletely. In any well regulated plant, tests for valve and piston leakage should be made once a week. Leakage of the upper discharge valves can be estimated by placing piston in bottom position with valves B and C open and by rapidly closing B. The rate of pressure rise above the piston gives an indication of the valve leakage (provided that the piston is tight).

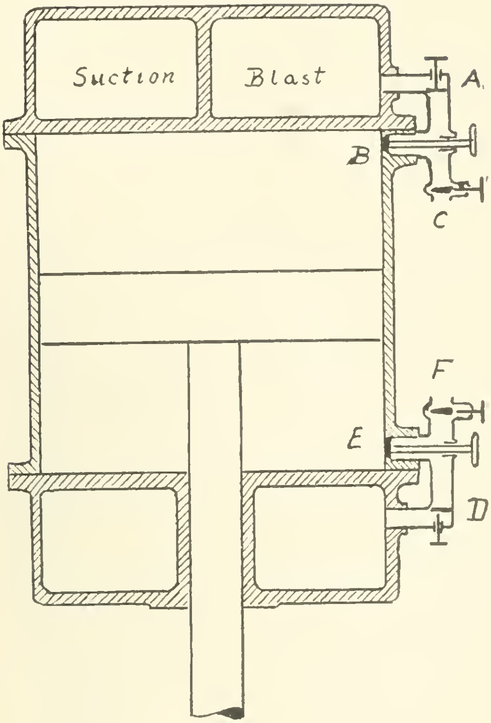

FIG. I.

With leakage either eliminated or accounted for, the second factor, namely, the relation of air density outside of air cylinder can be investigated.

This factor, which means ratio of air density (at end of suction stroke) in cylinder to air density of cylinder, is always less than unity. It varies with the size of the air cylinder, with the area exposed to inflowing and outflowing air, with the time during which the air is in contact with the heated surface, and above everything, with the temperature range of the

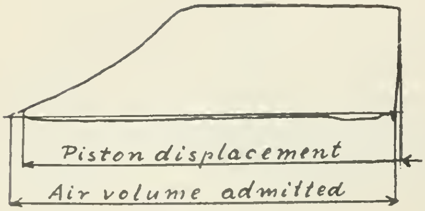

FIG. 2.

cylinder. Fortunately, the first three variables really vary very little in blowing engine practice, so that the influence of the temperature range is the only one which need be considered in practice. From tests made by the author and from tests published elsewhere, the following table was prepared:

Blast pres. lbs.	10	12	14	16	18	20	22	25	30
Density Factor	.93	.92	.91	.90	.89	.88	.87	.86	.84

Size of engine and design exert an influence which cannot be entirely overlooked, but conceding that influence, we may say that the values of the table are probably correct within 1½ per cent. either way. This means that for 20 pounds per square inch blast the factor may be as high as 89½ per cent. or as low as 86½ per cent.

A few examples will show the use of the tabulation. Fig. 2 is an idicator card taken from a blowing engine with mechanically operated piston inlet valves and with mechanically closed pot outlet valves. The apparent volumetric efficiency from the card is 97.2 per cent. Blast pressure is 17, hence density factor equals .895 which makes the volumetric efficiency equal to $.895 \times 97.2 = 87$ per cent. The air cylinder is of 9 ft. diameter with 5 ft. stroke; speed was 40 revolutions per minute, hence air delivery of that cylinder end is $.7854 \times 9^2 \times 5 \times 40 \times .87 = 11{,}000$ cu. ft. per min.

Fig. 3 is an indicator card taken from a blowing engine with automatic plate valves and with inlet pipe. It is evident that the pressure at the end of the suction stroke rises (due to the momentum of the air in the inlet pipe) above the atmosphere. The apparent volumetric efficiency is 100.7 per cent. The blast pressure is 15½ pounds which means a density factor of .903. The volumetric efficiency is $100.7 \times .903 = 91$ per cent. From the diameter of the air cylinder, the stroke and the revolutions per minute, the air delivery is easily found.

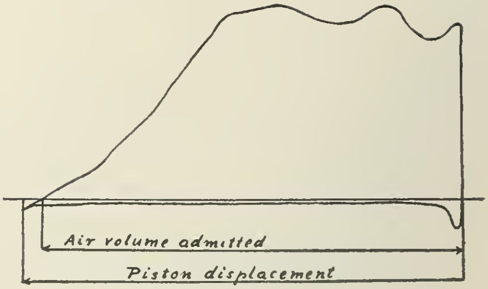

FIG. 3.

It is understood that, for the determination of the air weight passing through the engine, air temperature and barometric pressure at the inlet to the engine must be known.—*Blast Furnace and Steel Plant.*

VARIED USES OF A PNEUMATIC TAMPING OUTFIT

BY CHARLES BRENNAN*

The acuteness of the labor situation in 1915 necessitated a substitute for track laborers, and as the larger steam roads in the East during the seasons of 1914 and 1915 were using pneumatic outfits with excellent results in ballasting track, this company turned its attention to the tamping question. After going into the situation thoroughly it was decided to try out the pneumatic type of tamper. An order was accordingly placed for equipment for a trial test, and upon the completion of this test, which was highly satisfactory, an order was placed for a gasoline-engine-driven pneumatic tamping outfit. The following description shows to what varied uses such an outfit can be put, and the economies which are effected thereby.

The first outfit obtained was gasoline-engine driven and it was purchased in 1915. With this equipment 12,714 ft. of track was tamped between Oct. 1 and Dec. 2, 1915, in addition to miscellaneous jobs completed. In the spring of 1916, a 10-h.p. motor-driven outfit was put into service as being more economical for an electric railway, although it had to be towed, whereas the gasoline outfit was self-propelled. Both outfits came from the Ingersoll Rand Company.

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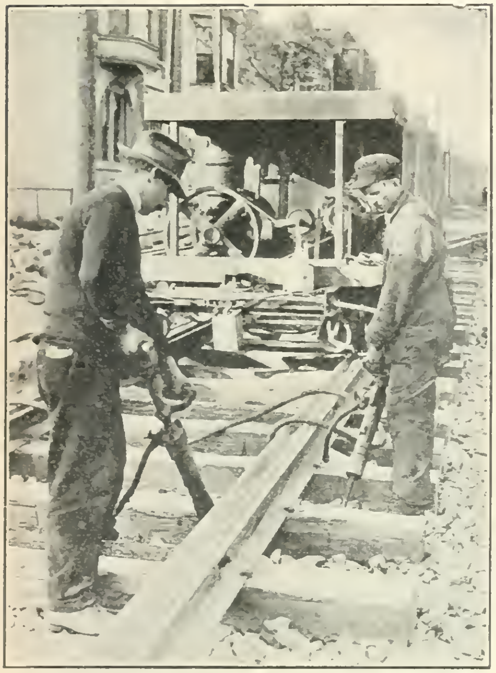
*Engineer Maintenance of Way, United Traction Company, Albany, N. Y.

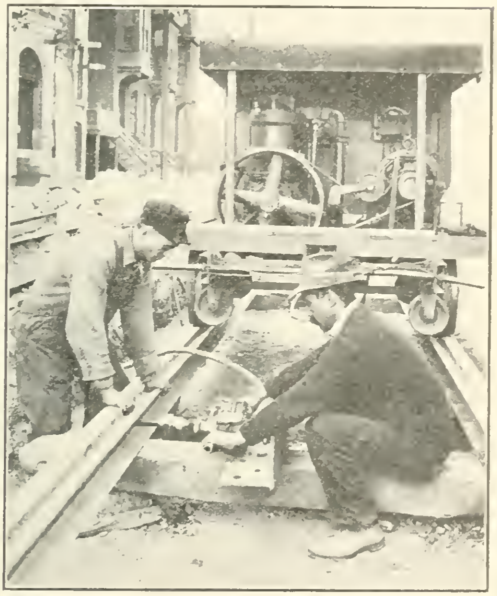


TAMPING TIES.

At present a test, namely, that of using four guns instead of two, by the substitution of a 15-h.p. motor for a 10-h.p. motor and by changing to a larger pulley, which an Eastern railway property is trying out, is being watched with considerable interest. If the test proves successful, it is the intention of this company to remodel its outfit accordingly, as it now operates but two tamping guns. A compressor outfit mounted on a wagon that will operate from four to six guns will be built in the United Traction Company's shops during the coming winter.

TOOTHING OUT POCKETS IN BRICKS.

In reballasting, where tracks are being reconstructed in connection with improvement of streets, and where traffic is being carried on continuously on both tracks, an outfit mounted on a wagon with wide tires is easier to handle than one equipped to run over tracks, since it weighs in the neighborhood of 4,500 lb. Where track is being reconstructed without traffic operating over it, the latter outfit can be placed on the tracks and can follow up the work, the operator moving the machine along as required. The present outfit is operated at a working pressure of from 70 lb. to 80 lb. without objectionable noise.



DRILLING RAILS.

Under continuous traffic conditions, the average cost of hand tamping 6 in. to 10 in. of crushed stone ballast is approximately 15 cents per foot of track. This cost, however, is increased where a second tamping due to settlement is necessary or where the ties are not absolutely on a solid bearing, as cracks in the concrete base will appear where concrete is poured under traffic. This condition is minimized when the track is tamped by the pneumatic outfit, as the stone underneath the ties is very compact. Also, indifferent tamping by hand is eliminated. As the tamping guns work at any angle this outfit is especially efficient in tamping ties in special work and in corners where a tamping pick or tamping bar would be useless.

The average cost per day of tamping in 1915 by the pneumatic outfit was as follows:

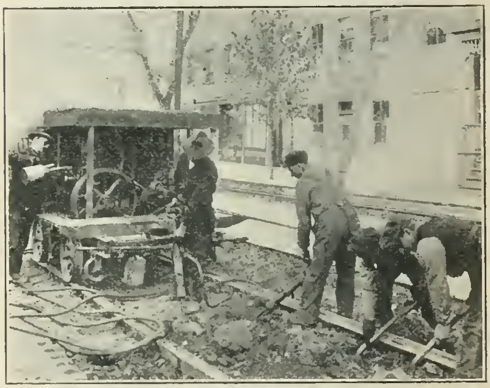
DISTRIBUTION OF TIE TAMPING COSTS

Operator	$2.75
Two tampers	4.20
One ballast distributor	2.00
74.6 kw.-hr. at 1 cent per kw.-hr	0.746
0.3 gal. compressor oil	0.075
0.5 lb. Polarine cup grease	0.045
Overhead*	1.08
Total cost per day	$10.896
Cost per tie	0.065

This tamping outfit cost about $1,300, the two tamping guns $100 each, and the tamping bars $1.75 each. As the pneumatic outfit is still engaged on tamping track, the average cost for 1916 has not been compiled, but undoubtedly will be higher, due to increased wages paid this year to all classes of labor. These figures serve to show a saving of approximately 56 per cent. A true comparison is the net result at the end of the season, and to keep the actual cost a job order is assigned to cover the operation of the tie tamper for the season in connection with a job order issued to cover the particular reconstruction job. At the completion of each job the cost of ballasting can be readily obtained. Another factor to be considered is the increasing number of laborers required on reconstruction work. The tamping outfit will take the place of at least ten laborers, and these laborers can then be used to good advantage ahead in tearing up and reconstructing tracks. Laborers were needed very badly during the past summer, and as most way engineers know there was not a job this year that had half its quota of men.

The municipal engineers of the several communities through which this road operates were so well pleased with the work of the pneumatic tamper that they requested that it be used on certain jobs, and having only one outfit we were kept busy moving it to the various municipalities when we could do so consistently.

Excellent results in the breaking up of concrete base have been obtained by the following procedure. Rather than work continuously off the face of the concrete, as it has been our experience, the base can be removed more quickly by a series of trenches and cross trenches, and the slab between can be pried up and broken off with sledge hammers. The laborers operate guns with dull pointed bars at an angle of 45 deg. and at about 2 in. or 3 in. from the face, at the same time using the gun as a lever to pry up the concrete slabs. If they try to take off too much the drill will stick. In order to effect an economy it is necessary to let the men cutting trenches in the concrete get a good start so that the laborers breaking and loading the concrete will not be delayed.



DRILL CUTTING OUT CONCRETE.

In order to clean bridge rollers and seats from rust successfully it is necessary to remove the guns and cut down the opening in the hose to a small size, as the compressor will not build up or hold the required working pressure with a ¾-in. hose connection. This scheme was used on one of the big bridges and better results were obtained by using one line of hose instead of two. In removing rust one laborer uses a sharp instrument to break up scales, dirt, etc., and the air blast will take care of the rest.

For drilling holes up to 1¼ in. in diameter two rotating air drills are used to operate in connection with the outfit, and the results so

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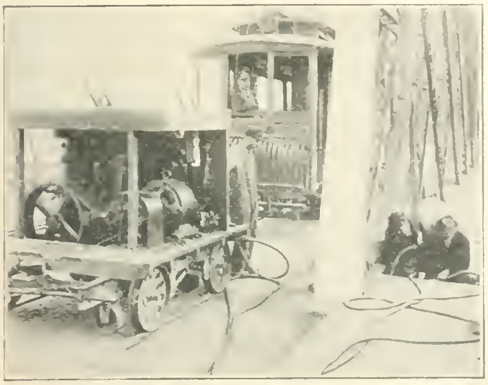
*Charges based upon a life of ten years at 6 cents per tie (180 ties considered a day's work).



BLOWER FOR RUST.

far to date have been very satisfactory. It is proposed by this company to use the outfit for drilling bolt and tie-rod holes in the short pieces of rail which are cut during the winter months as soon as the tamping work is completed. This will not only effect a saving but it will speed up the replacement of broken rails.

Anyone who ever attempted to pocket out half bricks preparatory to laying new blocks knows what a tedious and unsatisfactory job it is. As a rule, the whole brick adjacent breaks off, which requires that it come out also. By using a pneumatic chipping hammer a series of sharp blows does the work without breaking the adjacent block. In order, however, to secure a good bond in the toothed portion it is necessary thoroughly to clean the cement out of the groove of the old block. In cleaning the old block the brick is placed against the edge of the curb, and a dozen bricks can be cleaned, as against one by the hand method. Not much cleaning of brick has been done on the street, the tamping requiring the machine almost constantly. The old bricks are hauled to the storage yard, and when the outfit is not in use it will be used to clean this old brick.

These examples show how an outfit of this type can be used, and it is necessary for every way engineer to be on the lookout for all labor-saving devices if an indication of the rising labor market is to be taken as a criterion. —*Electric Railway Journal.*

200,000 acre feet of water was drained from overflowed land in Holland in 4 months by electrically-driven pumps having a capacity of 120,000 tons of water per hour.

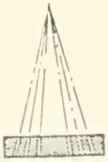


Fig.1.

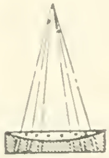


Fig 2

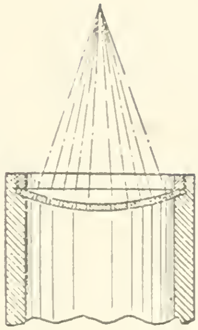


Fig.3.

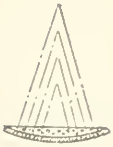


Fig.4.

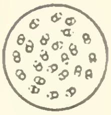


Fig.5.

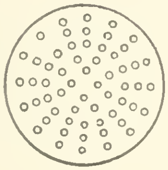


Fig.6.

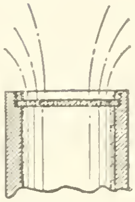


Fig.7.

GAS BURNERS FOR INDUSTRIAL WORK

When it is considered that 0.5 per cent. of carbon monoxide in air is sufficient to kill a robust human being, and that 0.1 per cent. is dangerous and that this gas acts as a cumulative poison, the dangers to health caused by improper methods of combustion of gas and defective ventilation are obvious. Many of the objectionable features of gas as a means of heating metal or other cold surfaces are overcome to a degree by mixing the gas with air under slight pressure previous to its arrival at the point of combustion. This gives a form of blow-pipe flame, and it is possible by this method to add to the gas the exact volume of air required for complete oxidation. The result of adding the requisite quantity of air to the gas is to make the mixture explosive, and to prevent it exploding back into the mains the mixture must be allowed to pass through and to burn upon a thick gauze or perforated plate. Back explosion is also preventable by increasing the speed at which the gas is flowing through the mains. A combination of the two, namely, a thin perforated plate and the gas flowing at a fairly high speed governs the method adopted in a series of experiments carried out recently by Mr. F. S. Sinnatt and described in the *Journal* of the Municipal School of Technology, Manchester.

The flame obtained by burning gas in this way was carefully examined, with the following results:—When the explosive mixture is allowed to burn upon a perforated plate or gauze, each perforation forms a separate flame which is very short, but has a large circumference. In order to burn as much gas as possible on unit surface the perforations must be made close together, with the result that each small flame will tend to displace those near to it. The flame consequently sprays out as shown in Fig. 7. The spraying becomes a source of danger when the gases are under pressure, for while it is possible for each flame to appear to be burning properly when examined by the eye, yet analysis will show that the gas is escaping unconsumed. The reason for this was found to be that the flames on certain perforations in the plate were not burning properly, and this was especially the case with those perforations near the perimeter when small discs were used.

Further, the author noticed that with any variation in the size of the perforations, especially where some became enlarged and others closed with foreign matter, the length of the flames on different perforations varied and the surface had peaks which stood out above the remainder of the flame. In cases where the design of the burner was faulty and the gas travelled down a main and then directly on to the perforated plate the rate at which the gas was flowing through the centre perforations was greater than through those near the perimeter. The flames, therefore, projected in the centre. If any of the above uneven flames are made to impinge against a cold metal surface a part may be extinguished or only partially burned, with the result that the gas escapes combustion. This is aggravated by the fact that the pressure and the composition of commercial fuel gases cannot be maintained at a constant figure, and that the flames are frequently employed in some machine which is subject to more or less violent vibrations.

Many of the above difficulties are overcome by making the perforated plate or gauze concave on the side upon which the gas is burning. The perforations should have a common focus as in Figs. 1, 2, 3, and 6, which can be varied by varying the degree of concavity of the plate—generally the perforated plates are made in the form of small circular discs, the size varying with the type of burner for which the disc is required, but usually ½ in. in diameter. The perforations in small groups may have a focus of their own as in Fig. 4. The whole of the flames burning on each of the separate perforations are thus made to pass through a common point, or the flames are focussed. The effect of this treatment is to overcome within wide limits any variations in the composition of, or the pressure of, the gas. It is nearly impossible for the gas to escape combustion owing to it having to pass through the common focus. The combustion of the gas is in a degree self-induced, and the rate at which the gas burns on the plate is increased by the thorough mixing which occurs. Differences in the size of the perforations cannot influence the flame to the extent they do on a flat perforated plate.

The flame upon a concave perforated plate or "dished disc" assumes a fairly perfect conical form, and after leaving the point of focus the burned gas is in a single stream. The point of focus of the plate may be considered to be the place at which complete combustion for the system will take place, and this may be taken as marking the point at which the flame may be brought into contact with cold surfaces. The distance this point is from the plate may be varied according to the design of the particular machine or plant in which the burner is required. The fact that the whole of the flames pass through the common focus causes that point to assume a maximum flame temperature. The degree of concavity required for different pressures and for fuel gases of different compositions was determined experimentally for the gases which have been burned by the system. The size of the perforations and the thickness of the metal of the plate are factors which influence the concavity necessary for any particular gas. At present the method adopted practically is to use small discs about ½-in. in diameter and to fit these into any type of burner; the number of the discs being varied according to the volume of gas to be consumed.

Just half a century ago the first shaft on the Calumet and Hecla was started. Since that time $130,750,000 in dividends has been distributed, equal to $2,615,000 per year since inception of the enterprise.

DERRICK AND CAISSON.

THE DEEP WATER PIERS AT HALIFAX

In the immense harbor improvement scheme now in process of realization at Halifax, Nova Scotia, the layout is for a passenger landing quay to accommodate the largest steamers afloat with buildings, railroad yards, conveyor tunnel and six piers 340 ft. wide and 1,250 ft. long separated by basins 350 ft. wide and 45 ft. deep. The piers and basins will provide berthing space for 27 large steamers at an estimated cost of $860,000 each. The sides of the piers are solid masonry walls 31 ft. thick made of courses of 22x31-ft. hollow, reinforced concrete shells 4 ft. high filled with concrete and rubble. The walls are founded on rock at a miximum depth of 60 ft. where they are seated on a rubble stone footing; in water not more than 45 ft. deep the rock foundations are leveled by drilling and blasting with drill boats and with a diving bell. In some places where the surface of the rock is too deep to be leveled by machinery and not deep enough to admit the use of a rubble footing, a concrete footing is placed under water in 64x120-ft. steel sheet pile cofferdams.

DIVING BELL WORK

Construction is now in progress on the passenger quay and one pier and basin where part of the surface foundations have been prepared by a diving bell or movable pneumatic caisson. This machine has a structural steel framework and a 25x38-ft. working chamber with concrete walls and a concrete roof about 2½ ft. thick. The structural steel framework of the working chamber is connected to the bottom of a skeleton tower of the same lateral dimensions with an open, central steel wall 11 ft. in diameter containing the airshafts and extending to the top of the tower 66½ ft. above the cutting edge. The lower end of the well is enclosed in a rectangular ballast tank 9 ft. high inside, covering the top of the working chamber and having walls and roof of solid 12x12-in. courses of timber. The working chamber is accessible through a 30-in. material shaft and a 30-in. man shaft adjacent to which the necessary air, water, and service pipes are provided.

The diving bell is sunk and a load of 40 tons on the cutting edge is produced by filling the ballast tank and well with water. It is raised by removing the water ballast and the buoyancy of the heavy ballast tank brings it to the surface. The working chamber will be operated under 20 to 25 lb. above atmospheric pressure.—*Contracting.*

COMPRESSED AIR FOR SALVING WRECKED SHIPS

Mr. W. W. Wotherspoon, who may be called the supreme expert in marine salvage, at least by the aid of compressed air, recently gave an interesting address before the Brooklyn Engineer's Club, an abstract of which is here presented:

Salvage conditions vary more or less with each case that is undertaken, and the devices and arrangement employed have to be adapted, often with much ingenuity to the specific requirements. Salvage contracts may be of three or more types: first, no cure no pay; second, no cure no pay except for a guarantee of certain charges; third, straight day's work.

DIFFERENT METHODS FOR RAISING SHIPS

Some vessels are raised after enclosing them in cofferdams, as, for instance, the notable *Maine.* Some may require to be merely patched and pumped out, and many are pulled off the bottom by lines attached to anchors, which are very much more efficient and positive than the efforts of the strongest tugs pulling directly. In some instances interior wood cofferdams are constructed in the vessels and enable the salvers to reach otherwise inaccessible places where portions of these ships may be repaired.

It would seem that for salving deep water vessels compressed air pontoons would be very efficient but owing to the great dimensions and corresponding cost of pontoons large enough to be serviceable for this purpose, none of the salvage companies employ them except for minor cases. For heavy work they should have a lifting capacity of at least 200 tons each and few or none such are in service except for one or two foreign governments.

STOPPING LEAKS

It is surprising to note how few leaks in a wrecked boat require calking; most of them are comparatively small cracks, open rivet holes, or openings around pipes, at imperfect flanges, etc. These can be easily closed and this generally suffices to make the vessel sufficiently water tight and air tight.

As most of the cracks in a vessel's deck are likely to be narrow, very often they may be patched without involving a difficult and unreliable system of shoring which is likely to become loose at the most critical moment, by a method devised by this company. It simply consists of drilling and tapping two or more holes through the deck and screwing into them bolts by which a 2x10-in. dry white pine plank is firmly held down over the crack and when it becomes wet swells and affords sufficient water tightness. Wrecked vessels must not only be pumped out but sometimes they must be ballasted and an interesting instance of the latter work is a vessel which was easily and successfully stabilized by the construction of wooden water tanks on her deck.

FLOATING WITH COMPRESSED AIR

Compressed air is used very widely for expelling the water from sunken ships, and at the same time furnishes very convenient power to operate drills and other tools. As the large majority of the injuries to vessels are on their bottoms the collection and maintenance of compressed air in the upper part of the hold is not affected by the holes through which it forces out the water, and the ship may be easily handled provided the decks and bulkheads sustain the heavy pressures.

THE WOTHERSPOON SYSTEM

To relieve excessive pressure the Wotherspoon system of graduated pressures in successive compartments has been used, and with it the inner compartment may be put under a very heavy pressure and the adjacent ones simultaneously put under somewhat lighter pressures, and so on, reducing the pressure outwards so that each bulkhead or deck has only to sustain a difference in pressure between the two adjacent compartments. Of course when a vessel is raised rapidly from a great depth under heavy pressure great care must be taken to prevent rupture by the unbalanced interior pressure as the exterior pressure is relieved. This often can be accomplished with a large open relief valve, as for instance, a submerged gooseneck which provides for automatic equilibrizing.

DIVING OPERATIONS

Divers' work often requires exceptional skill, courage and perseverance, and it may be of such a complicated nature as to make it difficult to decide between several plans for accomplishing the same end. This was the case with a vessel from which a large amount of silver bulletin was salvaged from the storeroom so located that it could only be reached by one of two difficult methods. By one of these it was necessary to cut a very large hole in the side of the submerged vessel and thus badly damage the structure. By the other method of cutting a smaller hole the three divers were subjected to great risk in proceeding clear across the vessel on a steep incline and through complicated and tortuous passages. The latter method was eventually successfully used.

DIVING UNDER HIGH PRESSURES

Although the work of the divers under compressed air is comparable with that of pneumatic caisson work and tunnel work, its limitations practically differ widely from the latter and divers have to go to depths of 150 or 200 ft., or even more, involving a much higher pressure than is considered practicable for caisson work. In the case of the Empress of Ireland, sunk in about 160 ft. of water, the divers descended as rapidly as the pressure in their suits could be balanced with the external pressure, and also ascended rapidly after a short period of work. As it had been observed that bad effects from decompression rarely showed themselves within 10 minutes after emergence, the men were allowed to come up quickly and were immediately placed in a hospital lock similar to those used for caisson work, and for a short time put under a pressure about one-third of the maximum to which they had been subjected under the surface. Later the pressure was reduced to one-sixth and maintained for a long time, and eventually to a still smaller proportion and maintained for several hours, a routine which proved entirely successful.

SEVERE AND FATAL ACCIDENTS

One diver lost his life through a rather unusual accident, namely, that of falling down a steeply inclined deck to a depth of about 60 ft. greater than he had been working in and thereby experiencing such a shock that he died very soon after being drawn to the surface.

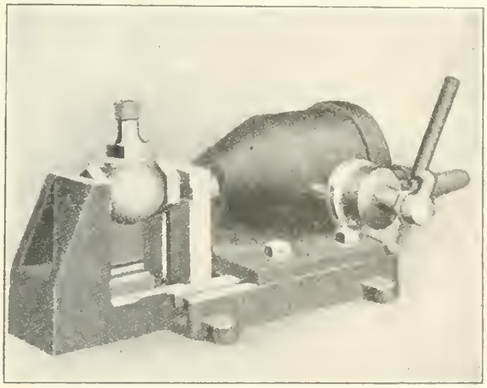
Diving was successfully carried on at a depth of 200 ft. in salving an English submarine where all of the divers escaped in safety except one who was the victim of an accident resulting in his becoming so badly entangled at the bottom that it took 12 hr. work by his companions to release him. At the time of his release the conditions of wind and tide were such that it was not safe to raise him to the surface and he therefore remained below 12 hr. longer and was then drawn out alive, although he died soon afterwards, more, it was believed from the result of the exhaustion and exposure than from direct compression. The other divers on the same job remained below the surface only about 15 or 20 min. and did not suffer therefrom. The greatest depth attained by a diver is 312 ft. which is the depth at which a United States submarine was sunk in the Philippine Islands. The divers worked 15 or 20 min. at this depth and then took from 6 to 8 hr. to ascend.

English experiments with tanks under artificial pressure indicate that divers can safely work under suitable conditions to a depth of 600 ft. and elaborate and comprehensive rules to govern their operations and insure their safety have been prepared from these experiments.

MOVING A SUBMERGED BRIDGE SPAN

In the discussion of Mr. Wotherspoon's paper, Mr. Frank W. Skinner described a remarkable application of compressed air and steel pontoons to the attempted salving of a long span of the Cornwall Bridge across the St. Lawrence River which after it was entirely completed fell on account of the collapse of one of its piers, and lay, substantially uninjured, on its side with the two trusses in horizontal planes in deep water with a current of 6 or 8 miles per hour. The current was so great that single piles driven in the river bottom were quickly broken by its force and fenders could only be constructed by driving clusters of piles and holding them until they could be chained together. Divers could only be sent down under shelter of strongly guyed vertical trough-shape steel shields with ladders on their concave faces turned downstream.

A number of air tight steel cylinders with valved inlets and outlets were floated over the spans, sunk into position parallel and adjacent to vertical posts of the lower truss and chained to them by divers. Compressed air hose was then attached to the cylinders, their valves opened, and air pumped in to expel the water until the increasing buoyancy of the cylinders lifted the span nearly to the surface of the water and enabled it to be moved down stream towards a sheltered position where it was intended to dismember it, remove the pieces of the structure, and re-erect them in the original position. Before it had quite reached a safe position it again grounded and although a larger amount of time and money was expended in trying to float it again the efforts were unsuccessful and the attempt finally had to be abandoned and the span destroyed.



PNEUMATIC VISE AND PIECE OF WORK.

A MACHINE SHOP VISE

The half-tone shows an air operated vise built by the Hannifier Manufacturing Company, Chicago, which should be a serviceable tool in almost any machine shop for holding small work on the shaper, miller, drill, etc., little explanation being required as to its construction or operation, which of course is instantaneous. The diameter of the air cylinder is 6½ inches and with the ordinary shop air pressure it can be made to apply a squeeze of more than one ton. False jaws may be applied to fit articles of special shapes and the space between the jaws may be adjusted according to requirements. The vise as here shown is 19-in. long over all and weighs 80 lbs.

COMPRESSED GAS AS A MOTOR FUEL

The use of compressed coal gas as fuel for motor cars has been pondered in many quarters during the last ten years, but so long as gasoline and its substitutes were fairly plentiful, the proposition was not considered good enough to warrant money being spent upon it. To-day, in view of the scarcity of all liquid fuels, there is a good deal more in its favor, and the Municipal Corporation of Glasgow has been carrying out some tentative investigations into the question. The results, while anything but conclusive, show, at any rate, that a motor vehicle can be worked successfully on gas, and point to the desirability of further experiments.

The initial disadvantage under which compressed gas labors, as compared with liquid fuel, is the space it occupies, and the weight of the cylinders required to contain it. A cylinder containing 100 cubic feet of oxygen at 1,800 pounds pressure weighs 120 pounds and measures 4 feet 7 inches in length. The cylinders for motor car use should be of large dimensions, so that the pressure can be kept as low as possible; hence the balance between pressure and volume must be very nicely adjusted, so that there shall be no undue sacrifice of reservoir capacity to lightness of load, or of carrying space to cruising radius. Two cylinders of not less than 8 cubic feet capacity could be placed one on each side of the chassis, below the footboards, between the front and rear wheels; but three cylinders would be even better, and the third might be placed at the back of the rear wheels, across the chassis. The greater the capacity of the gas cylinders, the lower the pressure required for a given quantity of gas; and, on this principle, the cylinders could be made much lighter and the working cost reduced all around.

A good deal of difficulty was experienced in devising a governor which would permit the training down of the gas cylinders so that the gas should issue at the outlet side of the governor at constant atmospheric pressure; allow for the passing of any quantity of gas up to 200 cubic feet per hour; and work without variation despite the jarring and jolting of the roughest roads.

This was at length accomplished. In the governor adopted the bell is of rubber, and the high pressure counter-balance on the valve stem is of leather. Between the high pressure storage cylinders and the motor a low pressure expansion cylinder was found to be necessary. The ordinary fuel tank was found to answer this purpose very well. As regards replenishing the storage cylinders with gas, it is proposed to use the car motor for the purpose, the pump to be operated from the gear box or connected up to the motor by a special clutch-gear.

It is hardly to be expected that compressed gas will ever compete with liquid fuel for cars traveling long distances, but there is no reason why it should not be cheap and satisfactory fuel for town vehicles working on comparatively short rounds. If the car can be made to do its own charging without unduly complicating the mechanism, or adding too much to the weight, the provision of charging stations would be simplified.—*Scientific American.*

AIR COMPRESSOR INDICATOR DIAGRAMS

The indicator diagrams on the opposite page, reproduced from a recent issue of Power, and contributed to that publication by Mr. R. S. Hawley, were taken from the air cylinders of a two-stage tandem air compressor, and they tell an interesting story. They show especially the importance of taking indicator cards at frequent intervals and they tell how badly a compressor may be performing when this is neglected.

The indicator in this case was apparently only thought of when other signs insistently showed that things were wrong. The compressor was pounding badly, its strokes were not uniform, the low pressure cylinder got very hot and, most important of all, the working pressure could not be maintained in the receiver.

It was evident from the first that the inlet and discharge valves, especially the latter, were not properly functioning. These valves are of the spring-poppet type inserted in cages and the cages screwed into the cylinder head. The inner end of each cage presses against a copper gasket, which should prevent leakage at that point.

The first cards taken were Figs. 1 and 2, from the low pressure and the high pressure cylinder respectively. Comparing these with Figs. 5 and 6, taken from the same cylinders after everything had been restored to approx-

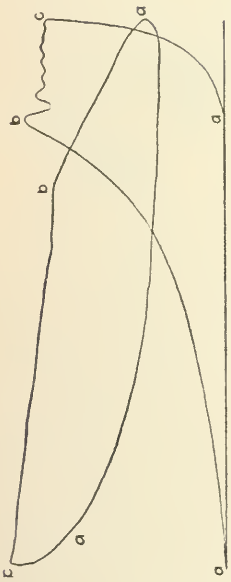


FIG 1

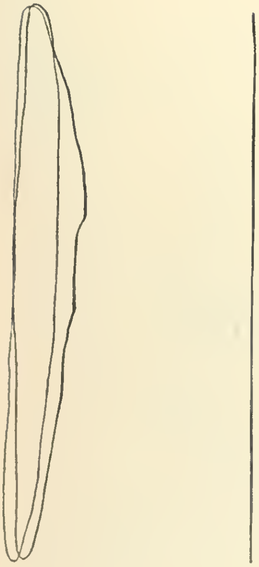


FIG. 2

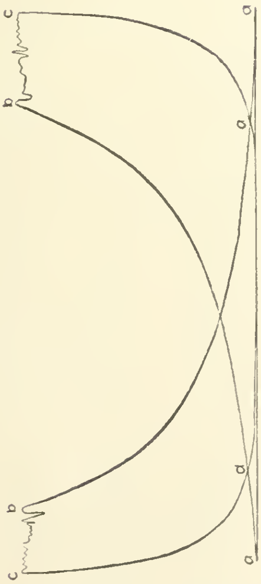


FIG 3

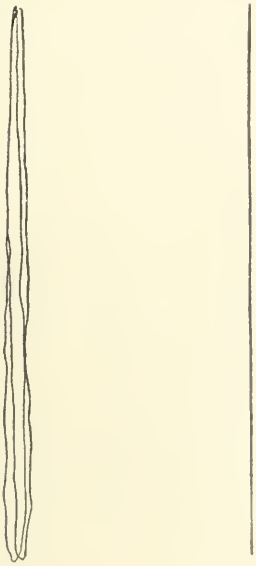


FIG. 4.

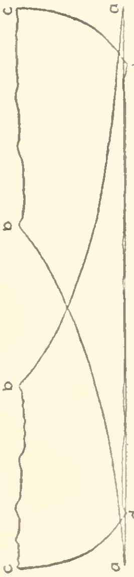


FIG 5

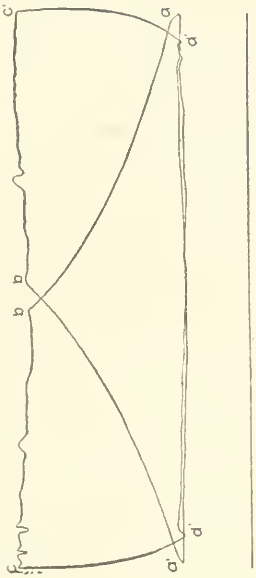


FIG 6

imately normal working condition, the contrast is astonishing. Of the four separate diagrams embodied in Figs. 1 and 2, only that from the head end in Fig. 1 is at all recognizable as a proper indicator card, the others being so bad that it is not worth while to try to understand their indications.

The valves of the low pressure cylinder were examined first and it was found that the gaskets under the cages were all defective or broken out, thus allowing the air to flow back into the cylinder on the return stroke after the compression. After these gaskets were renewed Figs. 3 and 4 were taken. Fig. 3 would pass for a tolerably respectable pair of cards from a single-stage compressor, which in fact they were, as Fig. 4 shows that the high pressure cylinder was doing none of the compressing.

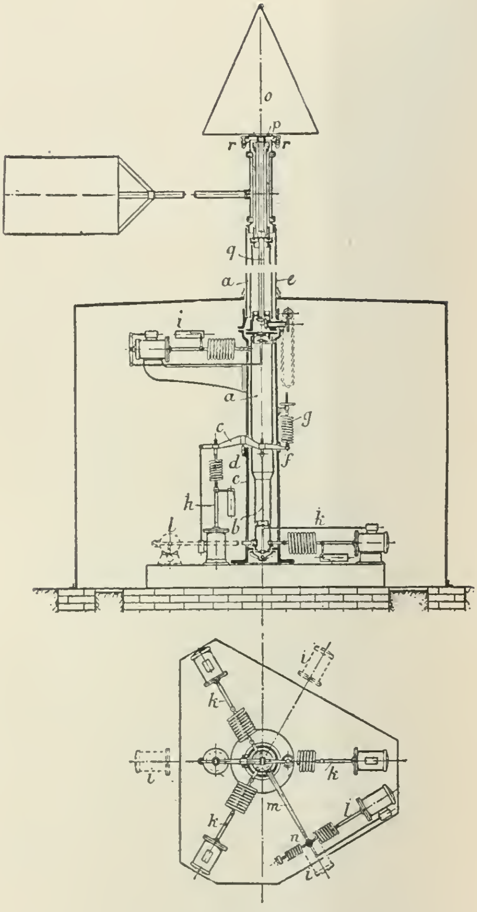
After the jackets had been renewed on the high pressure cylinder also, Figs. 5 and 6 were taken, showing each cylinder doing its full share of the work as determined by the terminal pressure and the ratio of the cylinder diameters.

MEASURING WIND FORCES*

Devices in use for measuring the wind pressure against plane or curved surfaces consist generally of a two-armed wind-mill carrying the surfaces in question, actuated by weights and connected with the beam of a balance. The velocity of rotation in still air is observed, and from this is calculated the force exerted upon the surfaces by a wind of known velocity. But in this way is obtained only the absolute value of the horizontal and vertical components of this force, with no indication either of its direction, of its point of application, or of its effective strength—all matters of great interest in the study, for instance, of the effect of the shape and inclination of the exposed surface upon the center of pressure of a wind of given velocity.

The Giessen indicator, which we describe herewith, has been awarded first prize in a competition, held under the combined auspices of the German ministry and several German technical associations, with the view of elaborating an instrument for the measurement of these items. It makes possible the separate determination of all components, and consequently of the direction and the point of application of the wind force upon the surface under discussion.

The apparatus (Figs. 1 and 2) consists of a tubular column, *a,* housed in a tube, *e,* which protects it against all direct wind action. The tube, *a,* is supported by means of a rod, *b,* connected with a lever, *c,* which in turn rests upon two springs outside the external tube, *e.* One of these, *g,* is adjusted to balance exactly the dead weight of the tube and the testing surface which it carries; the other, *h,* then measures the force of the vertical movement caused in the tube by the pressure of the wind.



FIGS. I AND 2.

The horizontal forces of this wind, and the oscillatory elements of the tube, *a,* under its pressure, are determined by two groups of three springs each, *k* and *i,* attached to the tube, *a*—the first group at a certain height above the foot of the apparatus, the second at this foot. Finally the forces of torsion resulting from application of the wind force are measured by a spring *l,* operated by the lever arm, *m;* a second spring, *n,* prevents all play of this arm, holding *l* in a state of constant tension.

At its upper end the tube carries a small plate, *p,* upon which is fixed the surface *o* being tested. This plate can be given any position desired with reference to *a* by means of a shank, *o,* fixed to *p* and adjusted from out-

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Scientific American Supplement. Translation from Le Genie Civil.

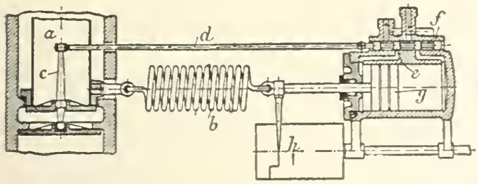

FIG. 3.

side the tube. On the other hand, this plate, *p*, can be rigidly fixed to *a* by means of the screws, *r*. These pass through holes in a socket which is provided with a little vane in such a way as to make it possible to maintain the testing surface in any desired relation with the direction of the wind.

The apparatus measures directly the vertical force transmitted by the tube, as well as the torsion forces. Horizontal forces, on the other hand, whose directions and intensities vary with the direction of the wind, are decomposed into three components at angles of 120 degrees with each other.

In measuring these components, since the movements of the tube naturally are of small amplitude (one millimeter, more or less), it is necessary, in order to secure accurate measurement, to use an auxiliary and automatic connection which shall at once measure and record the movements in question. This is represented in Fig. 3. It consists of a small compressed air cylinder in which moves a piston, *g*, directly connected with the spring, *b*. The latter, which we suppose to be attached to the tube, *a*, of the previous figures, represents any one of the springs of those figures. The lever, *c*, which moves with the tube, is joined to the rod, *d;* and this rod operates the valve, *e*, of the air cylinder, which can slide back and forth in the valve-box *f*. Finally the piston-rod, *g*, is joined to a recording needle, which is displaced upon the drum, *h*, with every movement of the piston.

A displacement of the foot of the tube to the left, for instance, pulls the valve, e, in the same direction, establishing the left-hand connection and admitting air to the left-hand face of the piston. This then advances to the right, stretching the spring, *b*, until the tension is just sufficient to pull the tube in the same direction back to its original position. This movement returns the valve *e* to its initial central and neutral location, arresting the displacement of the piston, *g*, by shutting off the supply of compressed air. Displacement of the tube in the opposite direction similarly brings about admission of the air through the right hand valve to the right of the piston, and a movement of this piston to the left, relieving the tension in the spring sufficiently to permit the return of the tube to normal position. In each case the amplitude of the piston movement, which, of course, measures the variation in tension of the spring, and through it the force of the wind, is recorded upon the drum.

In the indicator represented in Figs. 1 and 2 all of the springs, *h, i, k,* and *l,* are provided with this attachment, and are so placed that the return of the tube, *a,* in the direction contrary to the tension of the springs is effected without the latter ever being under compression, or even completely relaxed. The very slight play of one millimeter in every direction which the tube enjoys is sufficient to generate rapidly and without oscillation the movements of the pistons which work these springs.

BLASTING WITH QUICKLIME

The expansion of quicklime when wet develops an enormous force that acts slowly and almost irresistibly and has long invited use for mechanical purposes. A well-known engineer and contractor has spent a large amount of time and money trying to adapt it to raising heavy weights, as in underpinning buildings and other structures and more successful efforts have been noted in a recent issue of *Rock Products* that describes its efficient use in breaking up heavy brick masonry. A number of 12x20-ft. piers, 12 ft. high, were located between similar foundation piers for engines in operation and it was necessary to remove them without injuring the machinery. Blasting was therefore inadmissible and hand cutting and breaking too slow and expensive. The work was accomplished by drilling 3-in. vertical holes 3 ft. deep and 3 ft. apart in both directions over the entire areas of the piers and filling them within 6 in. of the top with fresh slacked lime in pieces ½ to 1½ in. wide. As soon as the lime was thoroughly wet the tops of the holes were filled with brick drilling well tamped and in about 10 min. cracks started in every direction and the entire top of the foundation pier was broken into 3-ft. cubes. Careful work was necessary since there was some danger of the tamping being blown from the tops of the holes.

MOTOR CONDITIONS AT DIFFERENT ALTITUDES

It is a known fact among aviation experts and aviators that at high altitudes the engine will not produce the power that it will when flying at sea level. This has caused considerable trouble to exhibition fliers and cross-country pilots when they wanted or tried to make flights from high altitudes, or had to make a high altitude in order to accomplish their purpose.

This reduction in power is due to the decreasing of the air pressure the higher up the machine climbs. At sea level, the atmospheric pressure is 14.7 pounds per square inch; at 5,000 feet above sea level, the pressure is 12.13 pounds per square inch, approximately, and at 10,000 feet, the presure is 10.0 pounds per square inch. It can be readily understood then, after the piston has driven the gas into the compressed condition ready for firing, that the final pressure so attained would vary as the atmospheric pressure dropped, the gas pressure in the cylinder would also drop, and when this takes place there is not as much power in the charge as there would be at a lower altitude or higher pressure.

Table showing atmospheric pressure at various altitudes.

Height.	Pressure. Lbs. Sq. Inch.
Sea level	14.7
1,000 feet	14.2
2,000 feet	13.6
3,000 feet	13.1
4,000 feet	12.6
5,000 feet	12.1
6,000 feet	11.7
7,000 feet	11.25
8,000 feet	10.8
9,000 feet	10.3
10,000 feet	10.0

The common compression ratio for an average motor is 4.5 to 1. That is, the air space above the piston has 4.5 times the volume when the piston is at the bottom of its stroke than it has when the piston is at the top of its stroke. This figure 4.5 is chosen because it is considered to be the best for maximum horsepower, and is one where the compression pressure will not be so high as to cause pre-ignition.

By having given the compression ratio, it is possible to determine the final pressure immediately before ignition by the formula:

$$\left(P' = P\frac{V'}{V}\right)^{1.3}$$

Where P' is the compression or final pressure, P is the atmospheric pressure, and $\frac{V}{V'}$ is the compression ratio of 4.5, $P' = 14.7\ (4.5)\ 1.3 = 104$ pounds per square inch, absolute, at sea level. Since this pressure comes directly from the compression ratio, it is the most efficient final compression pressure at sea level for an egnine with such compression ratio.

This same engine at an altitude of, say 7,000 feet, however, would have, since the atmospheric pressure at 7,000 feet would be 11.25 pounds per square inch instead of 14.7, as at sea level, $P' = 11.25\ (4.5)^{1.3} = 79.4$ pounds per square inch, absolute, which is 25.6 pounds per square inch less than the most efficient pressure, above determined. It is clearly evident then that not as much power will be obtained as when the engine was at the lower altitude.

These pressures calculated above are all "absolute," and by that is meant that the atmospheric pressure is also included in the figures, and in order to get the compression above atmosphere, the atmospheric pressure used in the calculations must be deducted. In the figures given, 104 — 14.7 gives 89.3 pounds per square inch, at sea level, and 79.4 — 11.25 gives 68.15 pounds per square inch at 7,000 feet.

In order to bring the final compression pressure up to the efficient figure, a different compression ratio would have to be used, that is, the final volume would have to be less, and since it is impossible to vary this to meet the conditions of altitude, the loss of power cannot be helped unless some arrangement could be devised whereby the compressoin ratio could be increased or decreased at will by reducing or increasing the space above the pistons when on top center. Then, if the ratio be thereby increased to some figure like 5 to 1, the motor would again have its proper final pressure, but even then, not as much power would be developed as at sea level, owing to the further fact that, with a constant final compression pressure, the horse-power varies directly as the atmospheric pressure. For example, the horse-power of an engine developing 80 horse-power at sea level when raised to an altitude of 7,000 feet would be equal to $\frac{11.25}{14.7} = 61.2$ horse-power. If the original compression pressure of 4.5 was used in circulating the drop in horse-power would be even greater.

These computations and remarks make it very clear that the flier or builder who contemplates any altitude work must see to it that sufficient surplus power be provided to allow for any variation or loss of power resulting from such altitude work.—*Aircraft.*

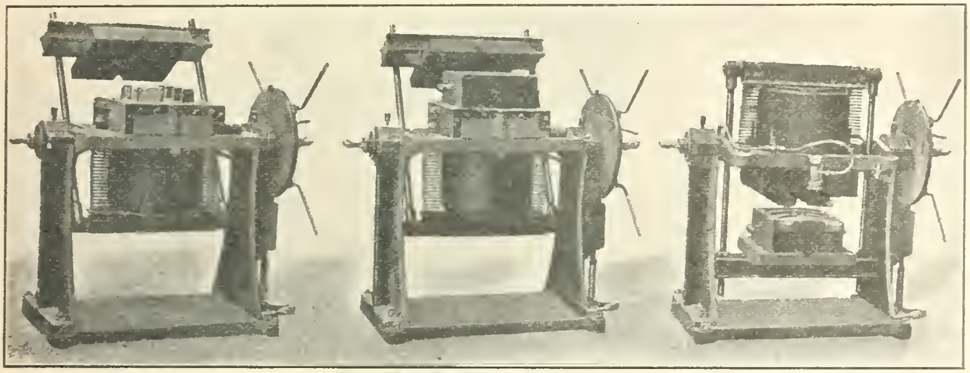

FIG. 1.

AN ENGLISH PNEUMATIC MOLDING MACHINE

The illustrations here reproduced from *The Engineer*, London, show the essential features and mode of operation of a new foundry molding machine built by Blakeborough and Sons, Brighouse, England.

General views of the machine are shown in Fig. 1, the first showing the machine in what may be called its normal or initial position and the other views the relative positions of the parts at different stages of the work. In Figs. 2 and 3 the machine is shown in elevation with the operative parts in two different positions, and in Fig. 4 are given details of the table and mold box.

It will be seen that the table A is mounted on trunnions B carried in bearings in the uprights C. To the underside of the table, Fig. 2, is attached a pneumatic cylinder D, with a piston E, the latter being connected to a crosspiece F. Secured to each end of the crosspiece is a vertical rod G, which passes through a slot in the table on each side of the box H. The upper ends of these rods are connected to a crosshead J, which carries the ram K. The mould-box is provided with a movable vibration frame L, to which the pattern plate M is secured. A three-way valve and pipe N passing through one of the trunnions conveys the air under pressure to the cylinder, so that the piston is driven downward, bringing the parts into the position shown by dotted lines in Fig. 2, and the pressing ram compresses the sand in the mould-box or flask. The pressure on the piston is then released by means of the three-way cock, and the piston is forced back into the cylinder by means of powerful springs O shown, and the surplus sand is removed. Pressure is then re-admitted by means of the three-way valve, and the pressure plate is again brought down on the box. When this operation is completed a roller on the end of the rod P, connected to the treadle Q, is withdrawn by pressure of the foot of the operator from an opening on the periphery of the hand wheel R, which is secured to the axis of the table. The wheel is then turned by hand through half a revolution, and the cylinder ram and box are turned to the position shown in Fig. 3, the table and parts being locked in their inverted positions by the engagement of the treadle mechanism with another recess in the hand wheel R. The air pressure is then released from the cylinder, and the crosspiece F is returned to the normal position shown in dotted lines in Fig. 3, owing to the action of the springs above mentioned. By means of the connecting-rods G the crosshead J and ram K, with the mould-box, are correspondingly lowered while in their in-

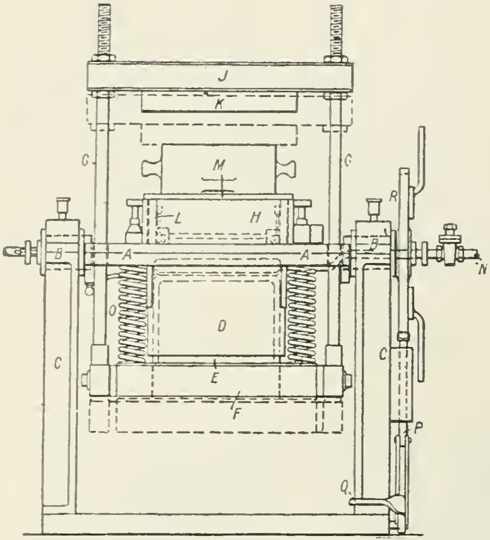

FIG. 2.

verted positions. Simultaneously the pattern plate and mould are lowered by means of the mechanism shown in Fig. 4. This comprises a system of levers, pins, and springs S, T, U. The machine is fitted with a vibrator W secured to the frame as shown. When the mould box is clear of the pattern plate the box, with the pattern or mould uppermost, can be lifted from the pressure block or ram on which it rests, and transferred to the floor. By depressing the treadle the roller on the end of the rod P is disengaged from the notch in the wheel R, and the latter is revolved by hand through half a revolution, bringing the various parts back to their original position, shown in Figs. 1 and 2, the pivotal connection of the rods G to the crosspiece F admitting of the crosshead J being moved to the rear of the machine, so as to give free space above the pattern plate for placing the molding box in position.

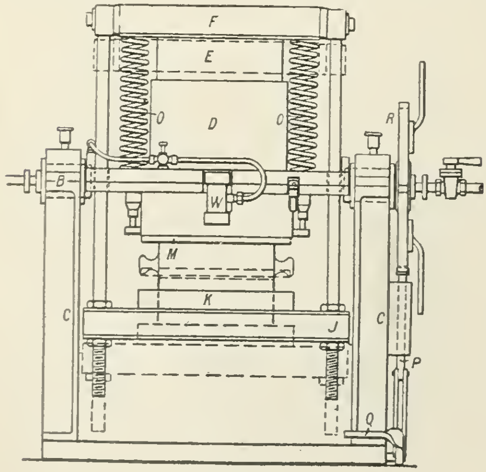

FIG. 3.

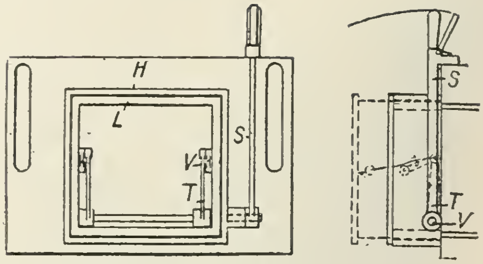

FIG. 4.

The machine is very simply and rapidly operated, and the impressions in the sand are sharp and clean. For the complete operation of making a set of six deep molds from a pattern plate in the foundry of the builders the time occupied was 1¼ minutes.

VENTILATION, CHILLS AND COLDS—ENGLISH AND CONTINENTAL PRACTICE

The question of ventilation is treated very differently in different countries. We in England are, or pretend to be, inured to chills and not very apprehensive of draughts, and think that this is a manly attitude. But on the Continent people often insist upon shutting railway-carriage windows when the Briton bares his brow to the wintry blast with complete (or pretended) indifference. Hence certain quarrels we have witnessed. Which is the right attitude?

Our theory appears to be based upon the view that we do not get chills when walking in the open air, and indeed feel the benefit of such exercise. But a person who is sitting in a draughty room or railway carriage is not taking the exercise which warms him against the cold of the atmosphere when he is walking. During a long railway journey we may become thoroughly chilled and open to the attacks of the numerous germs which are living upon our skin, throat, nose, or elsewhere, waiting for an opportunity to enter the deeper blood or tissues, or of other germs which may be hiding in the carriage cushions. The cold air may perhaps impede the attacks of the latter germs, but will tend, by chilling the patient, to encourage the former ones. On the whole, then, the case for sitting in draughts may be questioned; and there are numbers of subsidiary factors which are usually ignored—such as excessive meat-eating, alcohol, previous illness, and so on. Our theory that a close room means much poisoning with exhaled matter has been rather exploded by the work of Prof. Leonard Hill and others. It may be that the danger of being thoroughly chilled is much worse than the danger of infection by germs floating in the air of a close room. At all events, many people declare that they get colds by sitting in draughty places, while others say they get them by going to crowded assemblies in ill-ventilated halls.

Our mode of life is based upon our theories. Our sash windows are probably the most irrational things in creation. They appear to have been first invented in Holland, and brought over to England toward the close of the seventeenth century, in place of the rational French windows. It must have been a curious person who invented the former, which are often dangerous owing to the breaking of the cords, while a draught is always pouring in between the two sashes. What their advantage is, no one can understand, and we are glad to see that they are now being replaced again in new houses by the French windows. On the other hand, French windows, as will be easily seen anywhere on the Continent or in Egypt or elsewhere, may be closed to exclude either draught or noise. Moreover, seldom if ever do we have double windows such as are used throughout Northern Europe.

Our open fires do not warm the rooms, while they flood the atmosphere with particles of carbon, and are the most wastful method of producing artificial heat. On several occasions the writer has left England in the depth of Winter for Russia, Germany or Sweden, and has never been cold until he returned here. On one occasion a Canadian told him that England is the coldest country that he was ever in; and most foreigners make the same exclamation. In Russia the double windows are kept closed nearly throughout the Winter; the house is ventilated by proper arrangements of pure heated air brought up from the basement, with a great saving in cost and with the effect of enabling all the inmates to keep warm all day and night. In fact, in the middle of a Russian Winter people wear only thin undervests and sleep at night with a single blanket; while we shiver and shake before smoky fires and dress in thick semi-arctic clothing, besides having the privilege of wasting a large part of our income on coal. To be brief, Swedes, Germans, Russians and Canadians laugh at our arrangements. The writer has inquired whether colds are very frequent in Northern Europe and has generally been told that such is not the case, but that colds begin only in the Spring when the windows are first opened. As an experiment he once spent five days in Stockholm in December with windows closed (and remained perfectly well), but one comparatively warm night opened the window and heaped blankets on his bed as in England. The next evening a bad cold commenced.

Englishmen complain that rooms in Northern Europe are stuffy, but this may possibly be a mere auto-suggestion. Personally, the writer prefers the Continental system—one is warm all the time in the house, and when one goes out one can brave the outside cold in a thick coat without having been previously thoroughly chilled in the house.—*Science Progress.*

AIR DISTRIBUTION IN ACTIVATED SLUDGE TANKS

Mr. A. W. Haddow, acting city engineer of Edmonton, Canada, gives an interesting account of the compressed air distribution devices employed in the activated sludge tanks of the sewage disposal system.

The air main, he says, along the center of the tanks has been started off at 10 in. diameter. This 10-in. main is of cast iron, as it is found to be best for tapping and making tight connections for the down pipes. The tank under experiment has four 1½ in. down pipes, with a valve, and a Dart union below the valve on each pipe. They are placed 30 in. on centers and branch into two 1-in. pipes at the bottom of the tank running toward each end, where they are plugged. Each down pipe with its two branches is an independent unit, and by unscrewing the union it can be lifted for examination without interfering with the blowing on the three other pipes. The two branches are supported from channel irons by means of six ⅜-in. hollow rods (pipe), which by means of a thread and nut give a slow-motion control of the air pipes. After the air pipes have been set dead level, it is necessary both to raise and to lower them by means of these nuts to obtain perfect air distribution.

THE AIR PIPE PERFORATIONS

The air pipes have 1/8-in. holes drilled *on the under side* at 3-in. centers. This gives better distribution than drilling on the top or on the sides. So far, Mr. Haddow reports, the resulting air distribution is excellent. Each down pipe is connected, below the valve and above the union, to a branch from a 3-in. high-pressure water main (100 lb. per square inch) for flushing purposes. These four water branches are controlled by a single valve. In addition, the water can be shut off by a main valve and steam admitted through the same piping. Provision is made for expansion on this account. Then, as already stated, each air line can be lifted independently and cleaned, if the water and steam are not sufficient. A check valve is introduced on the main air feed, near the blower, to prevent water getting into the blower in case of carelessness in operating the valves.

ROCKS WHICH TELL THEIR OWN HISTORY

The walls of the Grand Canyon in Arizona form a great natural geologic section, in which each layer of rocks is in its original position relative to those above and below it. In few other places, however, is the story of the upbuilding of the earth's crust so plainly and impressively told. As a rule, the geologist who would decipher the records of the rocks must get a bit here and a bit there. He may find the edges of some beds exposed in a river bluff and others sticking out on a steep mountain side. He determines by fossils or other means the order in which the beds were deposited, and by putting all his information together he constructs what he calls a columnar section for the district in which he is working —that is, a section showing the order, thickness, and character of the beds. Such a section discloses the strata that form the upper part of the earth's crust at that place, just as a slice of layer cake shows at a glance the various layers of which it is composed.

After a number of districts in a region have been studied and their general columnar sections determined, the geologic history of the region can be learned by comparing these sections, just as the engineer who is drilling for low-grade copper ores compares his drill records and thus learns the outlines of the ore body. Such a comparison of the beds at one place and another shows how certain beds change in character and thickness from place to place or even thin out and disappear. It enables the geologist to draw some conclusions as to the former distribution of land and sea, to distinguish the deposits laid down in deep water from those spread by rivers over their flood plains, and to reconstruct in imagination the course of events at a time long before the beginning of the Grand Canyon. Such a comparison has recently been made for Arizona and is published by the United States Geological Survey, Department of the Interior, as Professional Paper 98-K, by F. L. Ransome, geologist. The report is obtainable on request from the Director.

Two Argentines, Señor Bradley and Lieut. Zuloaga, recently succeeded in crossing the Andes, starting out in a balloon from Santiago, Chile, and landing some four hours later near Mendoza, on the Argentine side. The report states that the aeronauts experienced contrary winds and ascended to a great height. This is the first crossing of the Andes by aeronauts.

SOMETIMES

Sometimes I long for a lazy isle,
Ten thousand miles from home,
Where the warm sun shines and the blue skies smile
And the milk-white breakers foam—
A coral island, bravely set
In the midst of the Southern sea,
Away from the hurry and noise and fret
Forever surrounding me!

For I tire of labor and care and fight,
And I weary of plan and scheme,
And ever and ever my thoughts take flight
To the island of my dream;
And I fancy drowsing the whole day long
In a hammock that gently swings—
Away from the clamorous toiling throng,
Away from the swirl of things!

And yet I know in a little while,
When the first glad hours were spent,
I'd sicken and tire of my lazy isle
And cease to be content!
I'd hear the call of the world's great game—
The battle with gold and men—
And I'd sail once more, with a heart aflame
Back to the game again!—*Berton Braley.*

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - Editor
FRANK RICHARDS, - - Managing Editor
CHAS. A. HIRSCHBERG, - Business Manager
W. C. LAROS, - - Circulation Manager

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THE PNEUMATIC MAIL TUBES

Compressed Air Magazine in a way stands for "Everything Pneumatic," yet it never advocates anything pneumatic simply because it is pneumatic, but only because while it is pneumatic it still has in each specific case practical reasons for its employment. We have no retainer for the defense of pneumatic postal tubes, but when their status is questioned and they are in danger of being unjustly dealt with it is our duty to have our say.

Pneumatic tubes were welcomed in the postal service of our larger cities as savers of labor and quickeners of distribution; they have a record of years of satisfactory service and had come to be regarded as an indispensable feature of modern postal efficiency. Nevertheless in the Post Office Apropriation bill now before Congress it is proposed to eliminate the use of pneumatic mail tubes in all our cities with the exception of a part of the service in New York.

It is reported that this proposition has been approved by the committee of the House of Representatives in charge of the bill by a vote of 9 to 6. It may be worth while to note that nine congressmen who would throw out the pneumatic tubes come from the following states: Tennessee, Indiana, Texas, Alabama, Kentucky, Kansas, California, North Carolina, Virginia, neither one of the number representing a constituency in touch with or having any interest in the pneumatic service.

The objection to the pneumatic tubes, so far as there may be any apparently valid objection, appears to be that while the post office business has been continuously and rapidly growing the pneumatic tubes have not grown. They, for instance, as they are at present, are of little or no use for parcel post service, which was not put in existence until years after they were installed.

While it remains the fact that the tubes will transmit first-class mail matter between local stations in times which must be counted by seconds of time, while minutes, with possible delays at all times, must be allowed for any means of street transmission, two possible common sense solutions of the problem might be suggested. The first would be to increase the capacity of the pneumatic transmission to meet the increased business thrown upon it, and the second way would be to still use the pneumatic tubes to the limit of their capacity and to supplement this by street transmission to whatever extent might be necessary.

Instead of this the proposition is for the Post Office Department to throw out the pneumatic tubes entirely, and to become the purchaser of great numbers of motor trucks. How great the numbers of such motor trucks might be, and how great a business interest is thus arrayed against the tubes, is suggested by the fact that some two hundred motor trucks are now employed in the mail service in Chicago, which number would have to be increased indefinitely with the abandonment of the tube service. Mr. Morgan, the most efficient Postmaster of New York, has estimated that it would be necessary to purchase three times as many motor trucks as there are now in New York if the tube service is curtailed as is contemplated, and that even with this increase the dispatch of the mails would be impaired, while the trucks would greatly complicate the general congestion of street traffic.

NEW BOOK

The Elements of Refrigeration. A Text Book for Students, Engineers and Warehousemen. By Arthur M. Greene, Jr., New York, John Wiley & Sons, Inc., 472 pages, 6 by 9 in. nearly 200 cuts, numerous tables and tabulated data. $4.00 net.

There are here brought together in orderly arrangement the data for designing, constructing and operating refrigerating apparatus with theoretical discussions of the principles involved. A detailed description of the application of refrigerating machinery to cold storage and ice making is followed by that of other applications which are numerous and diverse, as for instance, candy, breweries, blast furnaces, auditoriums, rinks, shaft sinking, chemical works, dairies, liquid air, etc., with related collateral information. There are numerous problems illustrating the computations to be made in refrigerating work. The book is copiously indexed.

The author refers to the various sources from which his information was assembled and handsomely thanks his wife for aid given in the preparation of the manuscript and in the reading of proof.

"HOW THE WINDOWS WERE BROKEN"

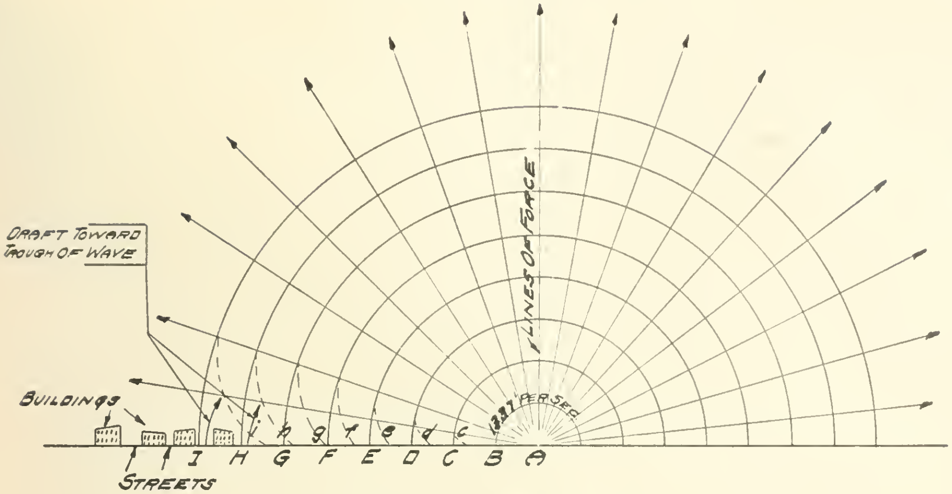
BY T. R. HAYTON.

The article with the above title by Mr. Frank Richards in the December issue of Compressed Air Magazine was on the whole quite interesting, and especially so to me, as I have for some time been making a specialty of handling water and air, but when it came to explaining the real cause of the glass breaking outward I did not see it in the same light. It is not my intention to give a strictly scientific explanation, and exact figures could hardly be made from a theoretical view point only.

Referring to the diagram, let A be the center or seat of the explosion and B, C, D, etc., distances out from A in all directions, covering a hemisphere or semi-globe, the arrows indicating the force as it radiates in all directions. The assumption is that the force would be theoretically equal at equal distances from the centre of the explosion. While this is no doubt true theoretically it will not be so practically, and for that reason I show dotted lines c-d-e-f-g-h-i which leave the theoretical lines at a distance above the ground and reach the ground at a distance much closer to the seat of the explosion. These lines represent the force in the shape of a wave as it radiates from the center, this to be described later on.

In a great explosion of this kind the earth is practically unyielding, while the atmosphere offers comparatively little resistance to the power turned loose. The earth being unyielding, the atmosphere gets the entire force expended, with the result that the adjacent air is literally blown out of that immediate locality and given a tremendous velocity outward in all directions. As it travels outward against the surrounding atmosphere it compresses it to a greater density. This air quickly gets into motion and a gigantic wave is launched outward in all directions. The entire force of the explosion is converted into kinetic energy or energy of motion.

As it travels outward and upward against the surrounding air the area or volume occupied rapidly increases and the speed decreases till it reaches a velocity of 1337 feet per second, which represents the velocity head equal to the pressure of one atmosphere. We may call this point B in the sketch. This is where the perfect vacuum or nearly perfect vacuum, as the case may be, ends. At this point we



ILLUSTRATING THE WAVE THEORY.

will have, say about two atmospheres of pressure at the crest of the wave and but little pressure in the trough of the wave which always follows the crest. Now as this wave travels out and up in all directions, its area increases and the pressure at the crest decreases proportionately. The partial vacuum following the crest changes for the same reason and in direct proportion to the crest. Its speed outward is practically uniform at all points except near the earth where it loses speed by contact with the buildings, trees and other obstructions. It is evident that the retarding of the part of the wave near the earth brings it in close proximity to the trough or partial vacuum which follows the crest and eventually causes it to be absorbed by the partial vacuum. In this way the pressure effect that always precedes a wave does not reach the earth after it has traveled a certain distance. The air being light it responds very quickly to a variation in pressure. It is also evident that eighty to ninety per cent. of the energy represented in the waves radiating from the seat of the explosion, is unaffected by friction at the surface. For that reason the trough of the wave can absorb the small part of the crest near the earth without being changed in pressure to speak of.

The nature of an air wave makes it rather difficult to explain, in that we can not see an air wave and, unless we had pressure instruments to register the pressure, we can not say definitely how much these variations will be. The force however must act in straight lines from the center out and up in all directions, and while the force causing the wave travels outward only from one particle to another, the air itself goes out for a distance and back and out again in a sort of vibrating motion. An air wave represents a layer of air that is under greater pressure than normal and followed by another layer that is under less pressure than normal. The size of the wave must depend on the force producing it. If the force is great enough to throw the air out to a distance of 300 to 400 feet from the center, it will practically double the pressure at that point and the momentum will carry it far enough to produce a partial vacuum nearly equal to the extra pressure of the crest.

The larger the explosion causing the wave the greater the distance between the crest of the initial wave and the crest of the secondary wave. It would seem that this distance should be a little more than double the distance from the center to the point where the speed amounts to 1337 feet per second. It is a well known fact that a wave in water runs according to the depth of the water and the force causing it. The greater the force the greater the distance from crest to crest.

It is also well known that a water wave does not require a large amount of power to keep it running. In fact it is remarkable how little power will keep it going. It sometimes takes hours for the waves to die down after the wind stops, especially is this true in large, deep bodies of water. It may be possible that an air wave will die out quicker than a water wave on account of the air being so light and rarified. Be that as it may, the fact remains that in some way the glass in the windows is broken, and the evidence points clearly to the fact that the pressure is lower outside than inside and that the expansion of the air inside breaks the glass.

It also seems clear that the wave solution offers the only logical theory that can be advanced for connecting the force of the explosion to the breaking of the windows. The theory of the friction causing the absorption of the pressure part of the wave near the earth and leaving the vacuum effect as the only effect felt in such cases, seems to be the only way of explaining this result. If we notice the telescoping effect of the smoke issuing from the exhaust of a locomotive and remember that the surrounding air causing the resistance is free to move, it will readily be seen that the resistance offered by obstructions that are stationary can easily cause the effect described.

This wave theory, however, is not the first one that came into the writers mind. The first theory was as follows: It is barely possible that this theory works in combination with the wave theory to bring about the vacuum responsible for the breaking of the windows. This theory is based on the well known law that it requires the same force to stop a body in motion that it takes to produce the motion in the first place. On this basis if we take for granted that the explosion turns loose for the instant a hundred million horse power, and that this energy acts in all directions out and up, starting the air off at a tremendous speed, and when we remember that nearly the whole of this force goes up into the space above, and that it continues to set the air in motion till this hundred million horse power is literally used up or consumed in losses, we must know that a partial vacuum is caused by the rush outward, and that there will be a rush back to fill the space caused by this great out-rush from the center. Then when we take into consideration the fact that no motion can occur in a fluid such as air or water without a difference in pressure, we can readily see that a partial vacuum will be formed in the vicinity of the explosion and that this vacuum will reach out as far as the force produces a perceptible motion in the air.

This briefly described theory was the first that I had on this cause. But I am now thoroughly convinced that the wave theory, while it may work together with this theory, is the one that is the more logical, and without a doubt is the true solution of the question at issue. We cannot expend any amount of energy in water without causing a wave. One drop of water falling in a body of water causes a wave to flow out, and this wave will run until it uses up the energy whether it be large or small, the greater the energy expended the greater the wave. We must recognize very nearly the same effect in air. The difference being mainly in its elastic nature. In this way the great force of the explosion at any point causes a rush of air out against the surrounding air, setting it in motion and it sets more in motion and so the wave runs until its force is expended and scattered over such an area as to become imperceptible.

Appleton, Wis.

HOW THE WINDOWS WERE BROKEN

Editor of Compressed Air Magazine:
Dear Sir:

The article in your October magazine by Mr. Frank Richards, on "How the Windows Were Broken," was very interesting and instructive, but I think he has missed one point that may have very largely entered into the breaking of the glass, and that is the effect of the "recoil." As is well known, every explosion is followed by what is technically known as the recoil. The effect of an explosion is, firstly, to consume a certain amount of the atmosphere at the immediate seat of the explosion, and, secondly, to compress and force back, by the tremendous expansion of the gases produced by the explosion, the atmosphere immediately surrounding the zone of explosion. This produces "the great surge of air over a large area" noted by the author.

This movement of the air away from the explosion naturally creates a partial vacuum at that point. It must therefore be, and is, followed by an equal reflex action of the atmosphere towards the place of explosion, in order to restore the equilibrium and pressure of the air at that point. Therefore, in the absence of exact time and pressure records within and without the buildings, proving irregularity of local pressures, and without reliable and exact testimony of witnesses at various points, which might have established the theory of Mr. Richards, that the phenomena were caused by sheltering or retarding buildings causing local vacuums, I am inclined to attribute the "vacuum" entirely to the recoil effect of the explosion.

If witnesses can be found, who noted positively that the windows fell outward coincidently with the first surge of the air away from the explosion, then Mr. Richards' contention could be established, but if there was an appreciable pause before the windows fell outward, and especially, if the observer was cool enough, and wise enough to notice the recoil, and the coincidence of the falling glass, then my point, that the phenomena were caused by the reflex action will be proven.

My own experience with explosions would lead me to believe that the observers were too closely engaged in running for shelter to have noticed with such exactness, and that it is unfair to add this new peril to the many imaginary ones already attributed to skyscrapers.

S. H. Brockunier.

Nevada, City, Calif.

THE FIRST LOCOMOTIVE WHISTLE

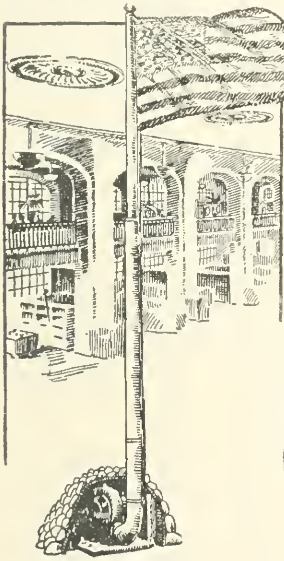
On May 4, 1833, there occurred an accident that gave us the locomotive whistle. It was on a level crossing between Bagworth and Thornton in England. Stephenson's locomotive "Samson" ran into a market cart containing 50 pounds of butter and 80 dozen eggs. A meeting of the directors was called, and Stephenson's suggestion of a whistle blown by steam was adopted. He went at once to a musical instrument maker in Leicester, who constructed a steam trumpet, which ten days later was tried in the presence of the board of directors. In appearance it was like a huntsman's horn, 18 ins. long and 6 ins. across at the top. It may be remembered that Rev. Sydney Smith, who flourished in those days, said that the whistle made him think of the squeal of a lawyer when the Devil first gets hold of him.

GASOLINE AND AIR

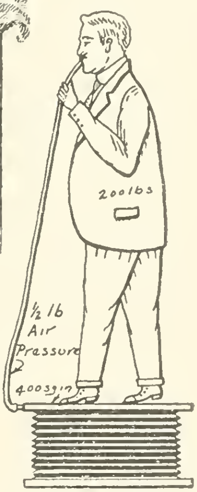
At ordinary temperatures, air will hold about 5 to 28 per cent. of gasoline vapor. As gasoline vapor is about 3 times as heavy as air, in a room containing a mixture of the vapor with air, the vapor is found in largest proportion near the floor.

The limits of explosibility of mixtures of gasoline vapor and air are between about 1.4 and 6 per cent. of gasoline vapor, although dangerous flashes may be produced with mixtures containing less and more than these proportions. In other words, there is needed only a small proportion of gasoline vapor to render air explosive—1.4 cu. ft. of vapor to 97.5 cu. ft. of air. One gallon of gasoline can under ideal conditions render 2,100 cu. ft. of air explosive.

A dangerous feature of gasoline vapor is that it may travel a considerable distance from the gasoline and there be ignited, the flash traveling back to the container of the liquid and causing a roaring fire in a few seconds.—*Bureau of Mines.*



ALWAYS A BREEZE.



BLOWING HIMSELF UP.

SAVING COMPRESSED AIR

A useful little expedient was adopted in the Milwaukee water intake shore tunnel by the O'Brien & Jackson Co., contractors. The tunnel is being driven under compressed air and in addition air chisels are used in some of the headings for excavating in hardpan and hard clay. The intermittent operation of the tools is apt to produce considerable waste of power in blowoff from the receiver. To avoid this waste, a blowoff valve set at 90 lb. was placed on the high-pressure air line within the tunnel, on the heading side of the air lock. Whenever the demand of the air chisels is low the excess high-pressure air escapes into the tunnel via this valve, and thus increases the low pressure air supply and reduces the load on the low-pressure compressors.

THE ENGLISH CHANNEL TUNNEL

Some nineteen hundred years ago when Julius Caesar tried to cross the channel, so he might get on the other side, he stood upon the mainland shore and wondered why so fair a chance had been neglected thus to dig a tunnel there. In all the years since Caesar's day through which the world has slid the average man of common sense has thought as Julius did. But Britons never thought that way, and they've been sure to balk when anybody dared to start the channel tunnel talk. Some were afraid and some were blind and all of them were slow and insular and insolent and British, don't you know, and for these nineteen hundred years that channel tunnel scheme has been to every Englishman a sort of nightmare dream. But now, Gadzooks, they're waking up; the war has showed them where they've made a nawsty, bad mistake, though not beyond repair, and some day in the by and by they'll chuck their doubts and fears and there will be a tunnel yet within a hundred years. No longer then that suffrage trip, but underneath the wave, and somewhere Julius Caesar will turn over in his grave!!!—*W. J. Lampton in N. Y. Herald.*

WHAT IS MAN?

A man weighing 150 lbs. approximately contains 3500 cu. ft. of gas, oxygen, hydrogen and nitrogen in his constitution, which at 70 cents per 1000 cu. ft. would be worth $2.45 for illuminating purposes. He also contains the necessary fats to make a 15-lb. candle, and thus, with his 3500 cu. ft. of gases, he possesses great illuminating possibilities. His system contains 22 lbs. and 10 oz. of carbon, or enough to make 780 doz. or 9360 lead pencils. There is about 50 grs. of iron in his blood and the rest of the body would supply enough to make one spike large enough to hold his weight. A healthy man contains 54 oz. of phosphorus. This deadly poison would make 800,000 matches or enough poison to kill 500 persons. This with two lbs. of lime makes the stiff bones and brains. No difference how sour a man looks he contains about 60 lumps of sugar of the ordinary cubical dimensions, and to make the seasoning complete must be added 20 spoonsful of salt. If a man was distilled into water he would make about 38 qts., or more than half his entire weight. He also contains a great deal of starch, chloride of potash, magnesium, sulphur and hydrochloric acid in his system. Break the shells of 1000 eggs into a huge pan or basin and you have the contents to make a man from his toe nails to the most delicate tissues of his brain.

NOTES

The deepest drill-hole in the world is said to be one in upper Silesia where a prospect bore-hole was cut by a diamond drill to a depth of 7,347 ft. This hole is 1.44 ft. in diameter at the surface, diminishing with depth to 0.157 ft. at the bottom.

Mining furnishes employment for all classes of men, from the most highly educated to the most ignorant. The direction of mining operations as well as much of the actual work involved, requires men of training and more or less education. Owing to the fact that mining involves every branch of engineering and nearly every science, a broad education is necessary for the men who must hold the higher positions.

Out in California a centrifugal blower, driven by an electric motor, is being used in the shelling of almonds. Formerly the nuts could be shelled by hand only with the greatest difficulty. At the present time the almonds are fed into the suction side of the fan, where they are picked up by the runner and hurled against the fan casing, following which they are blown out of the discharge pipe into a box, already shelled.

Blowing cotton from one department to another through suitable tubes is the latest employment of compressed air in manufacturing points. In one instance a California felt manufacturer makes use of compressed air for conveying damp wool from the scouring plant squeezers to another building across the street, in which are located the sun-exposed drying rooms. The method is of course clean and rapid.

In timbering the Twin Peaks tunnel at San Francisco preparatory to pouring the concrete lining, about 19,000,000 ft. b.m. of lumber is being used. A large part of this was purchased by the contractors from the exposition company. The 12x12-in. timbers used in the columns of the various palaces were found to be about the size desired, and for tunnel timbers they served as well as would the more costly lumber direct from the mill.

A number of cases are cited where the poisonous effect from the exhaust gases discharged by gasoline locomotives in mines caused illness among the workmen and finally compelled the use of the machine to be discontinued. When a motor is working perfectly, securing complete combustion, the gas discharged is almost wholly CO_2 and has very little effect on health. A gasoline engine, however, due to improper adjustment or other causes, will often discharge unburned gasoline vapor in large quantities and its exhaust may contain at times carbonic oxide, the dangerous character of which is well known.

A commission of prominent engineers made a report on Nov. 20 to the city authorities of Montreal on the water-power project which has been under construction for several years in connection with the city's water-supply. The commission finds that the final cost of the project will be at least $10,600,000, and that not over 7,000 hp. will be developed. The minimum fixed charges and operating expenses of the power plant will be $108 per hp. per annum, while the city could purchase power in the open market from some of the hydro-electric plants in the vicinity of Montreal for not more than $20 to $25 per hp. per annum.

Semi-steel, although not recognized in iron and steel nomenclature, ranks among the most valuable products of the gray iron foundry. the same cupola with regular gray iron mix-More than 100,000 pounds were produced last year to meet the demand for stronger metal and lighter sections. Semi-steel is made in tures. No extra coke, special appliances fluxes or new equipment are necessary. It is made in the same heat with other mixtures. It may be melted in the early part of a heat in the middle, or in the last part of a regular heat. It may begin with 30 to 40 per cent. steel on the bed and then follow with 20 to 25 per cent. steel. The product is 25 to 60 per cent. stronger than gray iron, thus permitting a large reduction in weight.

An American self-starter for aeroplane engines based on the employment of compressed air has recently made its appearance, says the *Scientific American.* To start an engine with this device, air contained in a tank is drawn through a control valve to a special carburettor, where it picks up petrol in a thoroughly vaporised form. Through an automatic distributor the compressed gas is fed to the engine cylinders in firing sequence. The compression is sufficiently high to cause the first piston—that on the compression stroke—to move downwards; sparking takes place, and the motor soon acquires its normal speed. Compressed air is stored in the air tank by means of a small compressor driven by the aeroplane engine.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

NOVEMBER 7.

1,203,645. VALVE-ACTUATING MECHANISM FOR FLUID-PRESSURE MOTORS. Thomas Winter Nichols, Gateshead, England.

1,203,862. PUMP, ENGINE, AND THE LIKE. Jean Zwicky, South Tottenham, England.

1,203,703. PULVERIZED - COAL - FEEDING APPARATUS. La Rue B. Chevalier, Iola, Kans.

1,203,709-10. APPARATUS FOR CLEANING COTTON. Eustice E. Dickerson, Fort Worth, Tex.

1,203,739. COTTON GINNING, CLEANING, AND BLEACHING MECHANISM. Wesley A. J. Hodo, Cleburne, Tex.

1,203,839. PLUMBER'S FURNACE. Arthur J. Archambault, Chicago, Ill.

1. In a plumber's furnace a main reservoir, an auxiliary reservoir arranged within the main reservoir, means for introducing air under pressure into one of said reservoirs, and a check valve for permitting air to flow from the latter reservoir to the other and preventing a back flow of air or liquid, said check valve including a spring tending constantly to close the same.

1,203,841. CENTRIFUGAL AIR-PUMP. Paul A. Bancel, New York, N. Y.

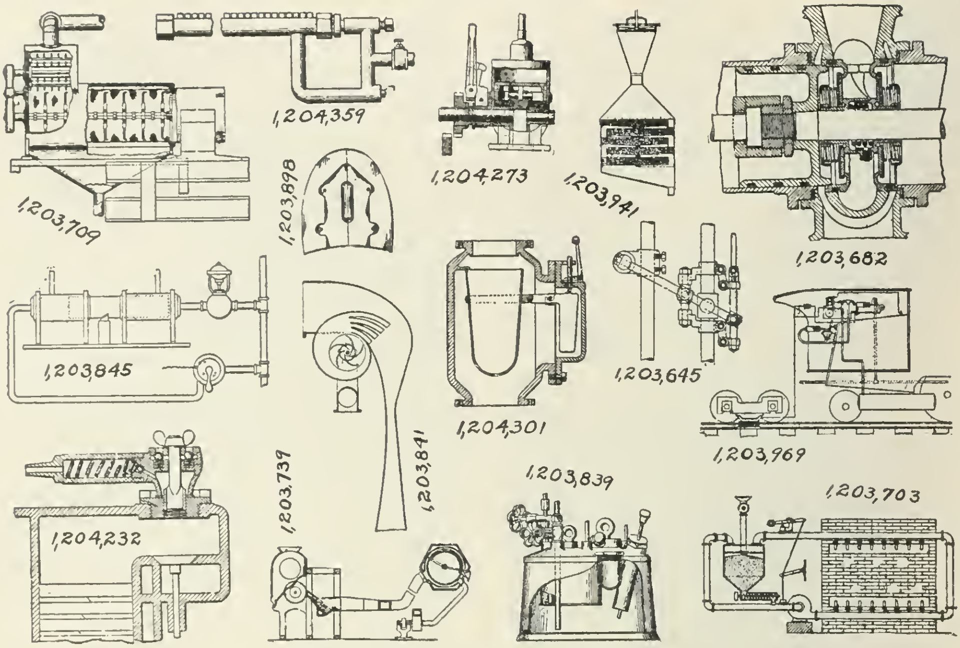
1,203,845. AUTOMATIC TRAIN-STOP. Carl H. Buhl, Cleveland, Ohio.

1,203,898. PNEUMATIC-CUSHION HEEL. Oscar Mussinan, New York, N. Y.

1,203,491. PROCESS FOR DRYING AND STERILIZING AIR. Reinder Pieters van Calcar, Oegstgeest, and Jan Ellerman and Hendrikus Johannes Martijn, The Hague, Netherlands.

1,203,969. AUTOMATIC TRAIN STOP. Melbern B. Bulla, El Paso, Tex.

1,204,273. AIR-PUMP. Roland C. Hilton, Boston, Mass.

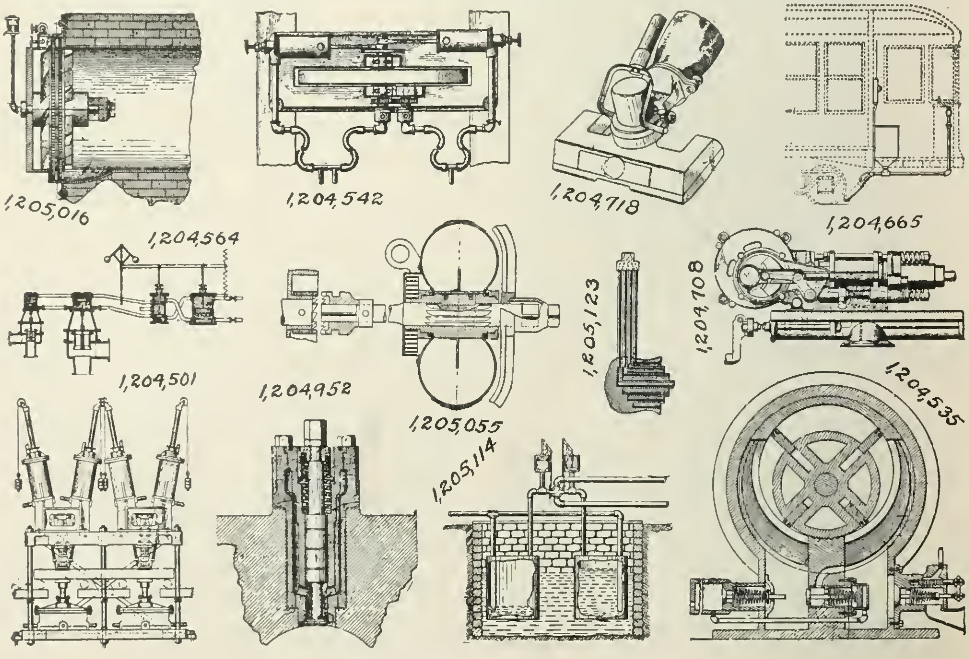


Pneumatic Patents November 7.

1,204,232. PNEUMATIC - TIRE - INFLATING DEVICE. Andrew Anderson, West Brighton, N. Y.

1,203,301-2-3. VACUUM-BREAKER. Harry E. Morton, Boston, Mass.

1,204,310. PNEUMATICALLY VARIABLE TENSION-REGULATORS FOR MUSICAL INSTRUMENTS. August Phillipps and Oswald Philipps, Frankfort-on-the-Main, Germany.



Pneumatic Patents November 14.

1,204,359. MULTIPLE BLAST-BURNER. William W. Kemp and William H. Van Horn, Baltimore, Md.

NOVEMBER 14.

1,204,458. VACUUM-CONTROL VALVE FOR MILKING APPARATUS. Herman A. Kricke, Crows Landing, Cal.

1,294,501. SPIKE - DRIVING MACHINE. Grant B. Shipley, Pittsburgh, Pa.

1,204,535. COMPRESSOR, PUMP, OR THE LIKE. Benjamin F. Augustine, Buffalo, N. Y.

1,204,542. PULSATOR FOR MILKING MACHINES. Lionell Bull, Libertyville, Ill.

1,204,564. FLUID-PRESSURE RELAY-GOVERNOR. Willibald Grun, Frankfort-on-the-Main, Germany.

1,204,665. TRACK-SANDING DEVICE. Benjiman Jones and Bertram S. Green, Syracuse, N. Y.

1,205,014. PISTONLESS PUMP. Joe M. Pressler, Jacksonville, Tex.

1,205,016. TURBINE-BLOWER. Joseph Roy Ramsey, Lykens, Pa.

1,205,055. AIR-STARTER FOR AUTOMOBILE-ENGINES. John K. Stewart, Chicago, Ill.

1,205,114. COMPRESSED-AIR WATER-ELEVATOR. Frank T. Shaw, Lordsburg, Cal.

1,205,123. SOAP-BUBBLE BLOWER. Chattin Bradway, Brooklyn, N. Y.

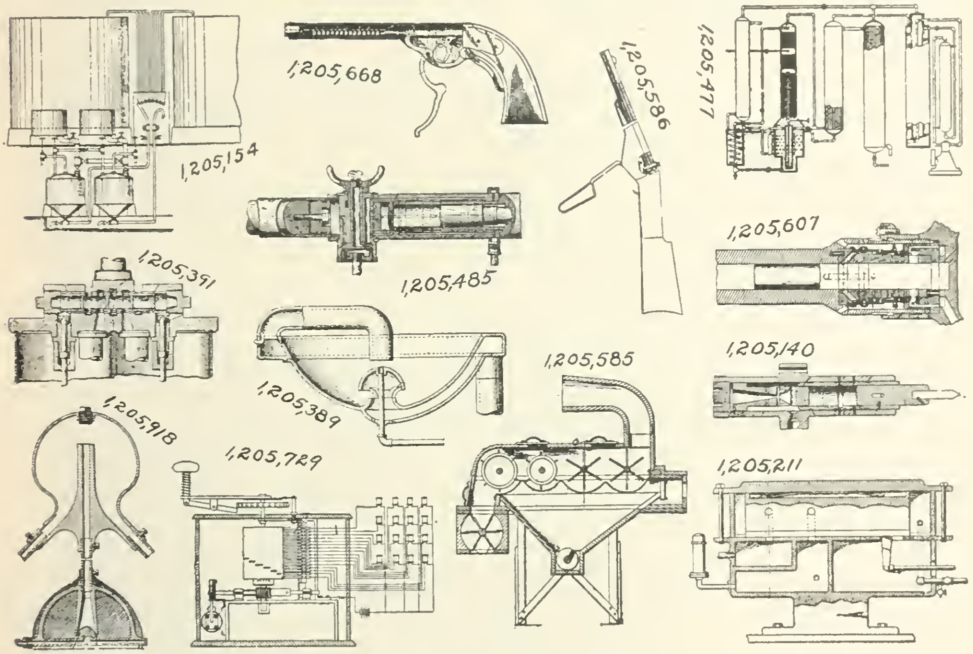
NOVEMBER 21

1,205,140. FLUID - PRESSURE - OPERATED TOOL. Oliver O. App, New York, N. Y.

1,205,154. WATER - PURIFYING APPARATUS. Otto Buedinger, Birmingham, Ala.

1,205,162. VACUUM - CLEANER. George Clements, Chicago, Ill.

1,205,211. TRAIN - STOPPING APPARATUS. Howard Jackson, Omaha, Nebr.



Pneumatic Patents November 21.

1,204,708. ROCK-DRILL. William A. Smith, Denver, Colo.

1,204,718. SUCTION CARPET - SWEEPER. John R. Vander Putten, New Philadelphia, Ohio.

1,204,803. FLUID-PRESSURE GUN. Peter A. McCullough, Pittsburgh, Pa.

1,204,831. PNEUMATIC SOUND - REGULATING MECHANISM FOR MECHANICAL PIANOS AND THE LIKE. Luis Jovell Vilar, Barcelona, Spain.

1,204,838. VACUUM-JAR. Frederick W. Bartlett, Caldwell, N. J.

1,204,952-3-4. AIR-STARTING VALVE FOR DIESEL ENGINES. Gregory C. Davidson, New London, Conn.

1,205,000. AUTOMATIC AIR-COUPLING. Roy A. McCurry, Pensacola, N. C.

1,205,001. PUMP FOR PNEUMATIC CARPET-CLEANERS. John J. Marko, Detroit, Mich.

1,205,389. OIL-BURNER. Walter G. Preston, Omaha, Nebr.

1. In a burner, a pan, a hot air conduit resting on said pan, the inner wall of the conduit forming a continuation of the pan, a burner cap mounted centrally with respect to the pan, means for feeding oil to said cap, and means for conducting superheated air from said conduit and discharging the same on said cap.

1,205,391. PNEUMATIC PUMP. Casper L. Redfield, Chicago, Ill.

1,205,477-8. ART OR PROCESS OF SEPARATING THE GASES OF AIR. James F. Place, Glen Ridge, N. J.

1,205,485. PNEUMATIC HAMMER - DRILL. Henry Schumacher, Denver Colo.

1,205,585. COTTON-CLEANER. Samuel Williams, Elk City, Okla.

1,205,586. AIR-COMPRESSION GUN. Robert Clifton Worley, Owens Cross Roads, Ala.

1,205,607. PNEUMATIC HAMMER. Frank M. Faber, Canton, Ohio.

1,205,668. AIR-PISTOL. Jacob R. Sandage, St. Joseph, Mich.

1,205,727. PNEUMATIC PIANO - PLAYER. Charles Freborg, Kankakee, Ill.

1,205,729. PRESSURE-REGULATING APPARATUS. Robert L. Frink, Lancaster, Ohio.

1,205,918. TRACK - SANDING APPARATUS FOR LOCOMOTIVES. Mark R. Miller, Charleston, and George L. Dibble, Florence, S. C.

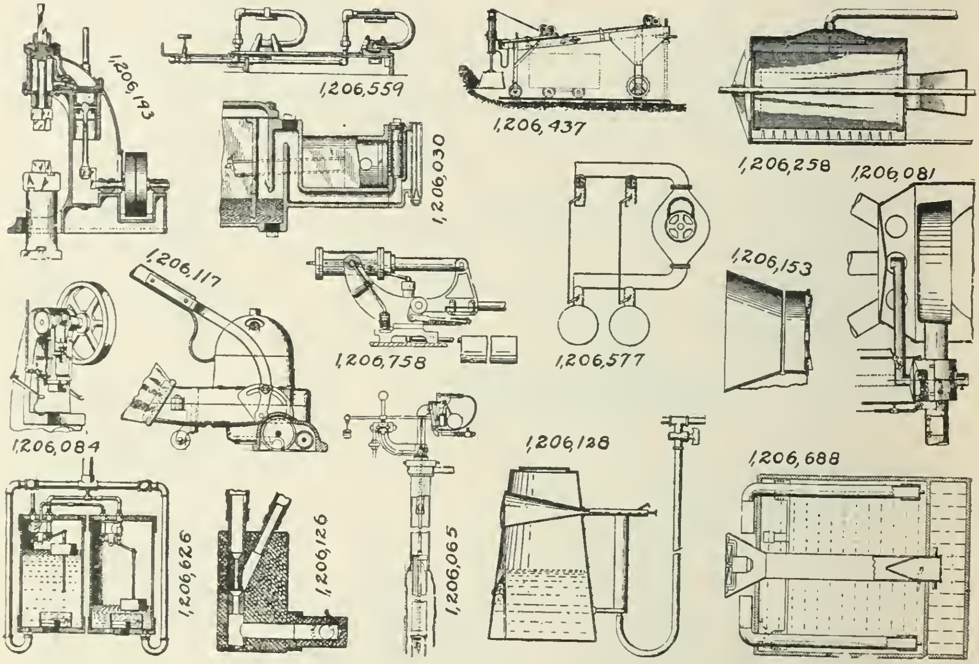
1,206,126. VACUUM-GENERATOR. John A. Mitsch, Boston, Mass.

1,206,128. SPRAYING DEVICE. Neil E. Morgan, Hermon, N. Y.

1,206,153. AIR - DIRECTOR FOR USE IN BURNING LIQUID FUEL. Henry Pelham Smith, London, England.

1,206,176. PNEUMATIC PLAYER. Eugene T. Turney, New York, N. Y.

1,206,193. PNEUMATIC POWER - HAMMER. Ralph E. Bates, Philadelphia, Pa.



Pneumatic Patents November 28.

NOVEMBER 28.

1,206,030. FLUID-COMPRESSOR. Walter J. Richards, Milwaukee, Wis.

1,206,065. DISPLACEMENT - PUMP. Elmer A. Watts, Springfield, and Irwin L. Dunn, Marietta, Ohio.

1. A mechanism for elevating fluids comprising a plurality of closed receptacles arranged one above the other and spaced apart, the lowermost receptacle communicating with a source of fluid supply, a conduit leading from the lower portion of each lower receptacle to the upper portion of the next higher receptacle, and means for admitting air under pressure to the upper portion of said lowermost receptacle, whereby the air will first discharge the fluid from said lowermost receptacle through one of said conduits to said next higher receptacle and will then follow the fluid through said conduit into said next higher receptacle and discharge the fluid therefrom.

1,206,081. AIR - HUMIDIFIER. Christian Becker and Frank D. Kleinheksel, Holland, Mich.

1,206,086. APPARATUS FOR DELIVERING AN INTERMITTENT AIR-BLAST. Reuben B. Benjamin and William Cottrell, Chicago, Ill.

1,206,116-7. PNEUMATIC CLEANER. James B Kirby, Cleveland, Ohio.

1,206,258. METHOD OF BLANCHING PEANUTS. Felix Salomon, Chicago, Ill.

2. The hereindescribed method of blanching nuts which consists in projecting membrane fracturing air jets against a mass of nuts, and moving the nuts during the application of the air jets to subject the several portions of the mass to the action of the jets.

1,206,437. TUNNELING-MACHINE. Samuel Hoar, Virginia, Minn.

1,206,559. HYDROCARBON-BURNER. Eppe M. Lucus, Van Alstyne, Tex.

1,206,577. CENTRIFUGAL COMPRESSOR. Sanford A. Moss, Lynn, Mass.

1. In an apparatus of the character described, the combination with a centrifugal compressor having inlet and discharge conduits, of throttling valve means in each conduit for throttling the flow therethrough, and means for simultaneously operating them.

1,206,624. PNEUMATIC HORSE - COLLAR. Lemuel E. Van Treese, Letts, Ind.

1,206,626. PUMP. Marion C. Walls, Clayton, Ind.

1,206,688. VENTILATING AND AIR-PURIFYING APPARATUS. John C. Fleming, Boston, Mass.

1,206,758. TROLLEY - POLE CONTROLLER FOR ELECTRIC CARS. Clarence V. Greenamyer, Los Angeles, Cal.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XXII. FEBRUARY, 1917 No. 2

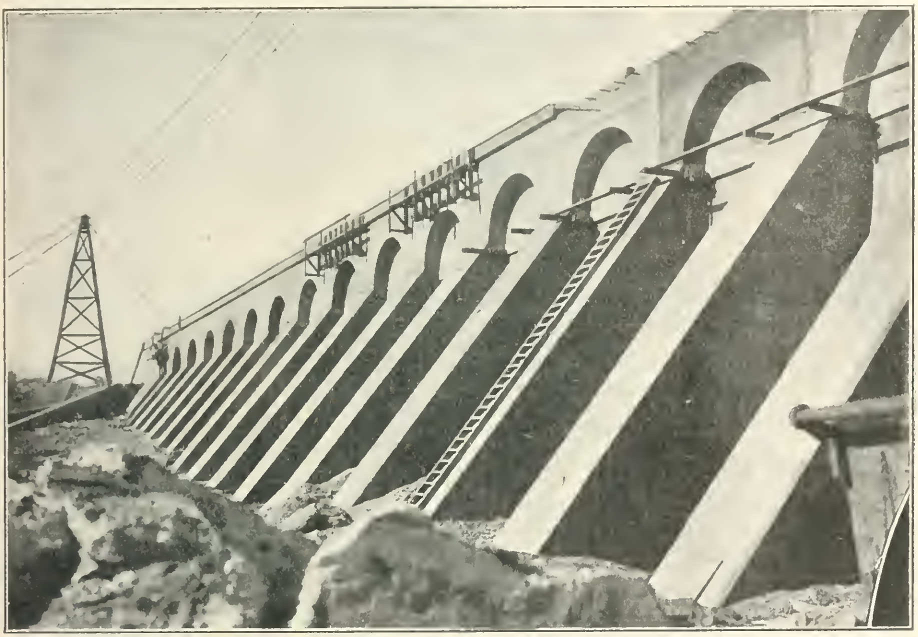


FIG. 1

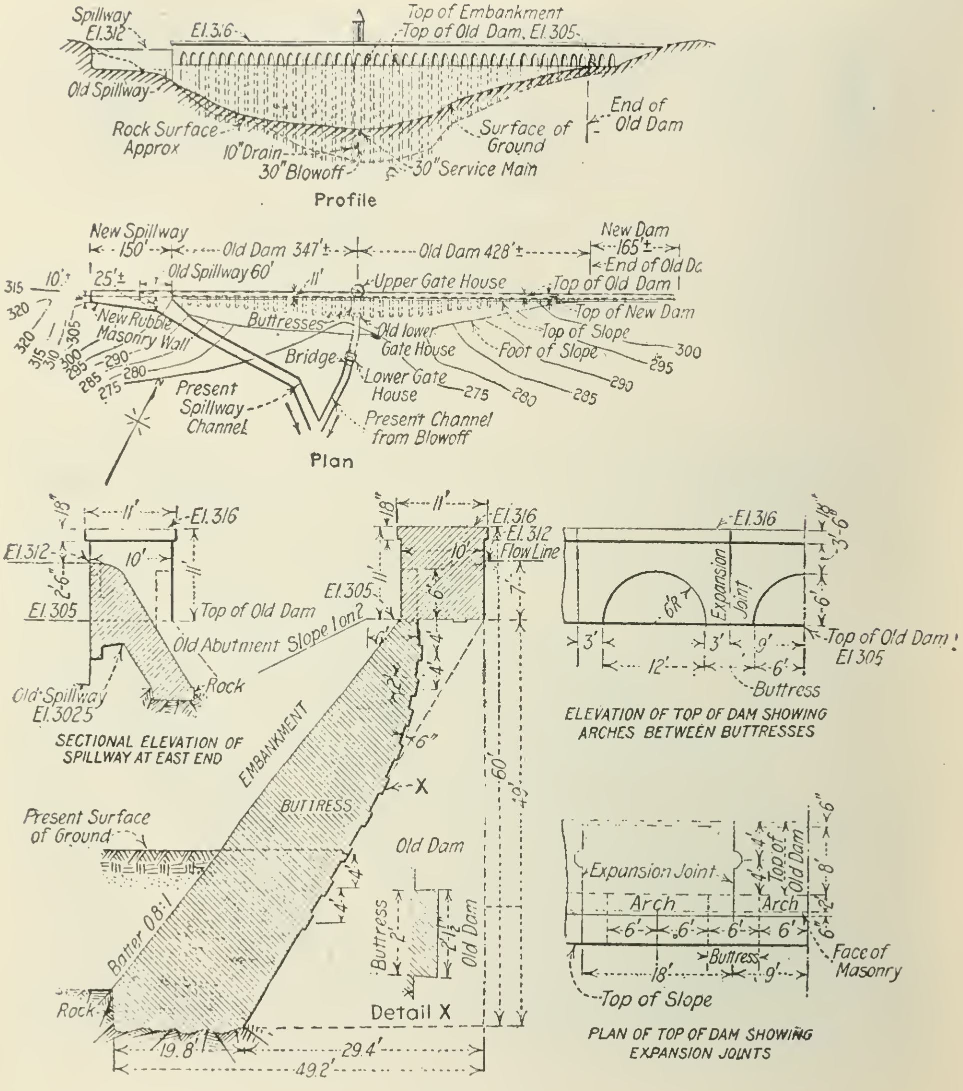
TRAP FALLS RESERVOIR ENLARGEMENT INVOLVING THE RECONSTRUCTION OF A DAM

BY CHAS. A. HIRSCHBERG

The growth of the city of Bridgeport, Conn., both commercially and in point of population, has been very marked during the past five years. In anticipation of a continuance of this growth, the Bridgeport Hydraulic Co., which supplies the city of Bridgeport with its water, has had under way various plans for an increased water supply.

The following is a description of work for the enlargement of Trap Falls Reservoir, one of the five links in a water supply system admitted to be most ample and satisfactory, especially when compared with the water supply systems of many cities of equal or even greater population.

The Trap Falls Reservoir lies in a natural basin approximately 8 miles above the city of Bridgeport, and before reconstruction covered an area of about 240 acres, closed at its outlet by a concrete dam of mass structure



Profile

Plan

SECTIONAL ELEVATION OF SPILLWAY AT EAST END

ELEVATION OF TOP OF DAM SHOWING ARCHES BETWEEN BUTTRESSES

PLAN OF TOP OF DAM SHOWING EXPANSION JOINTS

Detail X

MAXIMUM CROSS-SECTION OF DAM THROUGH CENTER OF BUTTRESS

FIG. 2.

built some 11 years ago, prior to the days of reinforced concrete engineering. The water is piped to the reservoir through 3 miles of 30 in. mains from the Far Mills River, which has a drainage area of about 7 square miles; also through 4 miles of 36 in. pipe from Mean's Brook, drainage area 8 square miles; total, 15 square miles.

The capacity of the reservoir before reconstruction was 1,400 million gallons, over 50% below the capacity for supply of the drainage area. The problem, therefore, involved the provision for larger storage capacity.

To avoid extended stoppage of the water supply from this reservoir, the company's engineers decided upon the reconstruction of the old dam, in accordance with the plan shown in Fig. 2. It is interesting to note that the work progressed without in any way interfering with the water supply except for a period

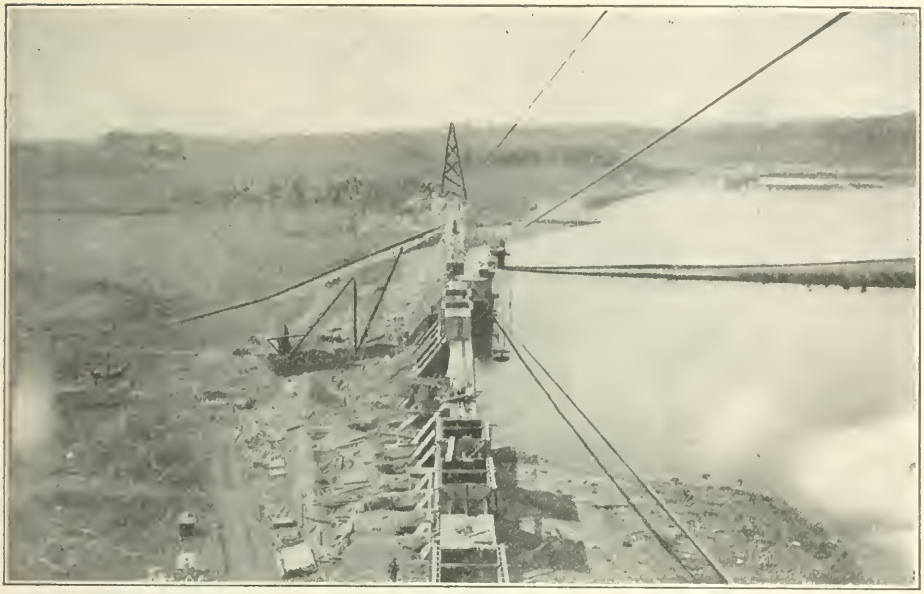


FIG. 3.

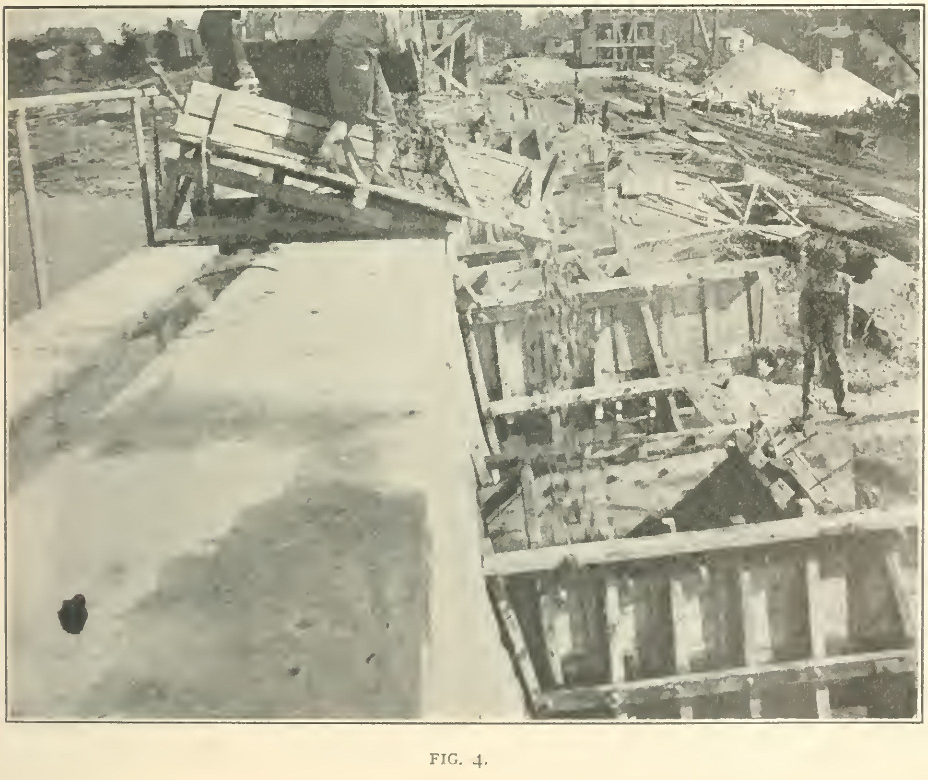


FIG. 4.

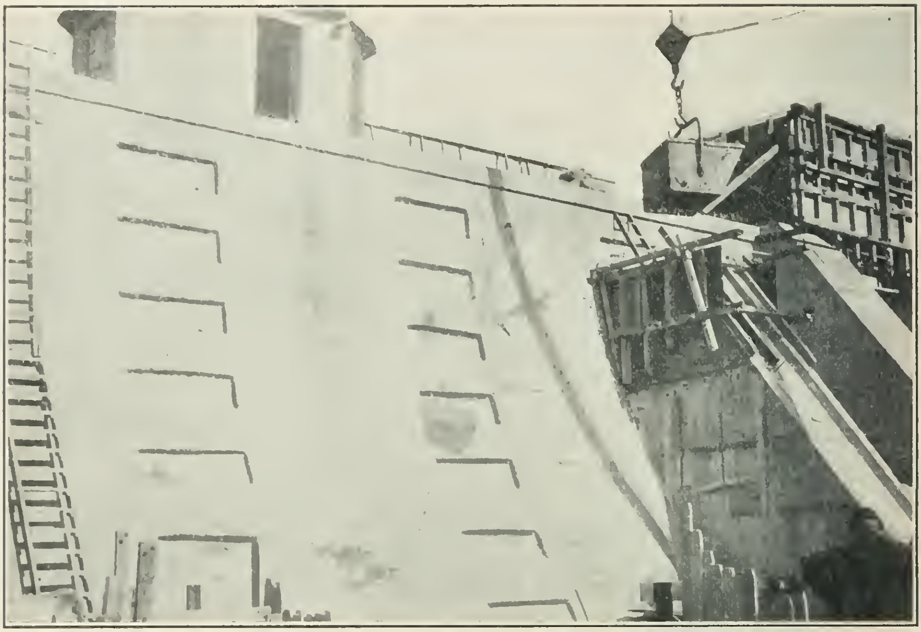


FIG. 5.

of one week during the placing of the concrete buttresses in the immediate vicinity of the service main.

A comparison of the old and the new dam structures, shown in Fig. 2, shows that it meant an increase in height of 11 ft. and an increased length of 225 ft.

The surface area of the reservoir is increased from 240 to 300 acres and it will have a capacity for 2,200 million gallons. It will be noted that the mean high water level of the old reservoir was 302 ft. as against 312 ft. for the new.

As already stated, the old structure was of mass concrete. No provision whatever had been made for expansion, and as a result the dam had developed cracks with slight leaks. In the reconstruction this has been provided for in a unique manner. Blocks of concrete 11 ft. high, 18 ft. long and 10 ft. wide were placed alternately 18 ft. apart and permitted to harden thoroughly before the intermediate blocks were poured. These blocks were joined to the old structure by means of a channel or key-way 18 in. wide and 4 in. deep, cut along the full length of the top of the old dam. This is shown in Fig. 4.

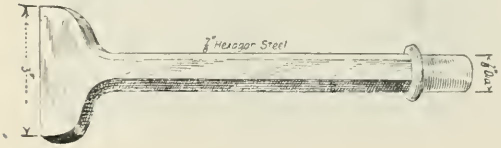


FIG. 6.

The increase in height made it desirable to brace the structure to take care of increased stresses. For this purpose 46 buttresses, as shown in Figs. 1 and 2 were provided. These buttresses are 6 ft. wide placed on 18 ft. centers and connected at the top by arches. These arches also support the overhang of the concrete blocks placed at the top of the dam.

The greatest problem presented in this work was perhaps that of tieing up the new additions to the old structure. In Fig. 5 is shown the method adopted to key the buttresses. So that they could take the thrust, mortise and tenon joints 6 ft. long by 4 ft. wide and 6 in. deep were made 4 ft. 6 in. apart on a vertical plane in the face of the dam.

DRILLING AND CUTTING THE MORTISES AND CHANNELS

The channel in the top of the dam and the mortises in the face were cut by drilling, broaching and picking, employing three Jackhamer Drills and three Little David Pneumatic Picks as follows:

Holes were drilled with a 1½ in. cross bit,

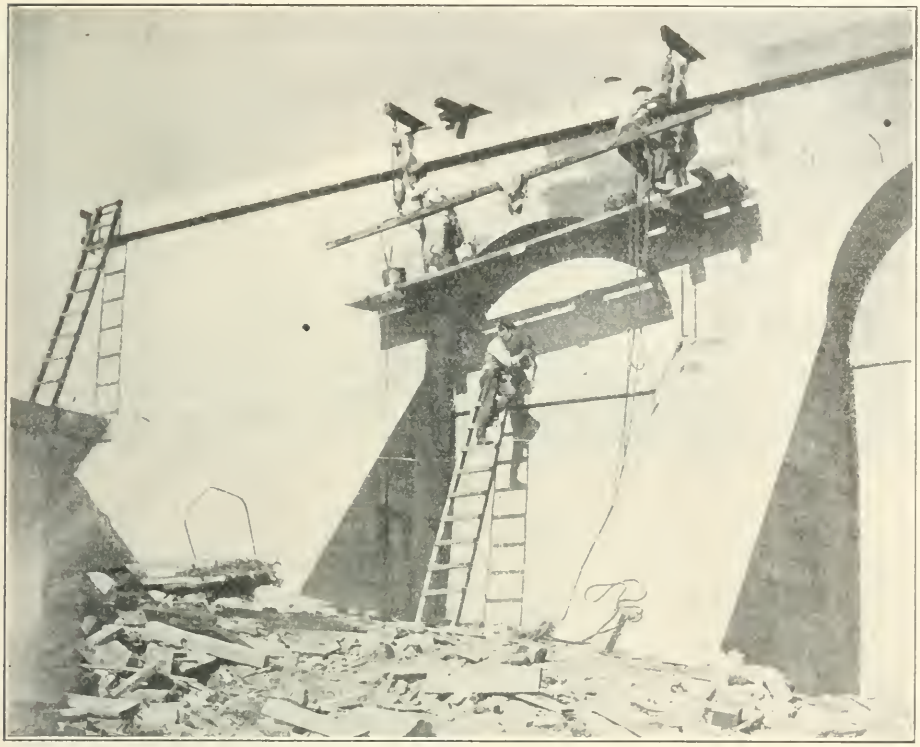


FIG. 7.

approximately 1 in. apart both along and across the channel to a depth of 4 in. This was followed by pneumatic picks employing a special broaching tool, as shown in Fig. 6, along the outside edge of the channel, breaking down the intervening concrete to form a continuous groove. An ordinary pointed pick was then inserted in the pneumatic hammer and the drilled concrete chipped out.

Holes 6 in. deep were drilled with Jackhamers as closely together as they could be gotten with a 1½ in. cross bit. The men operating the Jackhamers worked from suspended platforms, as shown in Fig. 3. The concrete between the holes along the edge of the intended mortise was then broached by the flat tool already referred to, and the remaining concrete picked out by the pointed pick operated by a pneumatic hammer.

In drilling these mortises the Jackhamers were supported in special hangers suspended from 2½ in. air pipe strung along the face of the dam. One man and a Jackhamer drilled and broached one complete mortise in 4½ hours, and one man with a pneumatic pick averaged one mortise completely chipped out in a similar length of time. These tools were also used for drilling concrete form anchor bolt holes to a depth of 6 in.

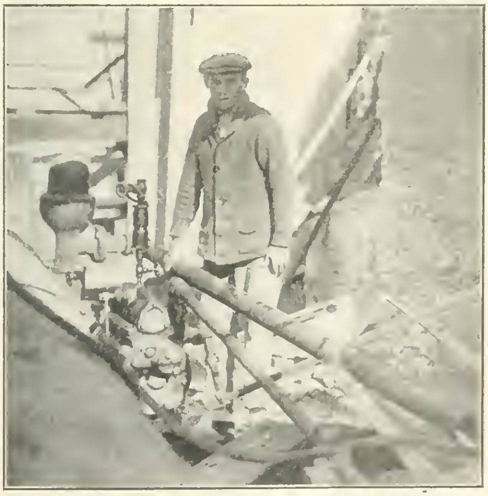


FIG. 8.

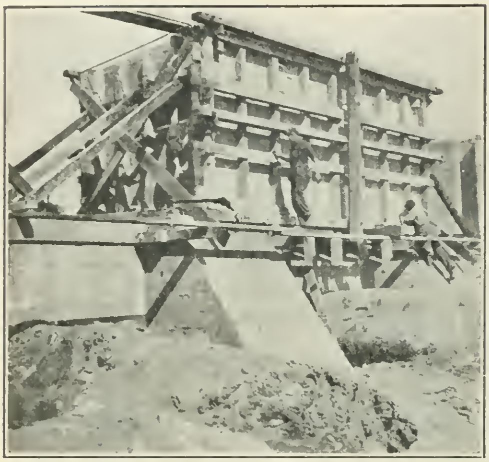


FIG. 9.

The air was supplied to the drills and picks by a 9 and 9x8 in. Class FR Piston Steam Valve Compressor through the 2½ in. pipe used as a supporting rail for special Jackhamer hangers. All steel was sharpened by hand, a total of 60 pieces of 12 in. lengths being required for the job, which comprised 213 mortises, 775 ft. of channel and more than 500 6 in. anchor bolt holes.

To obtain a suitable rock footing for the buttresses the overburden at the base of the dam was removed with pick and shovel. Where the natural contour of the rock did not provide a satisfactory footing, holes were drilled with the Jackhamer and blasted, the object being to obtain a saw-toothed surface.

Fig. 8 shows a Cameron Pump at work keeping the excavation free of water. This pump was shifted along from point to point, as required.

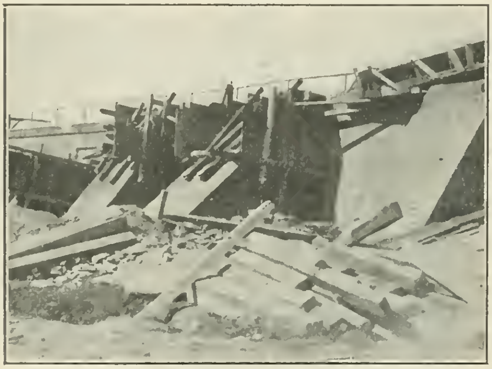


FIG. 10.

CONCRETING

Collapsible wooden forms were used for all concreting. See Figs. 9 and 10. Forms for the buttresses were shifted by stages towards the top, each pouring of concrete being permitted to set sufficiently before shifting the form. For keying each successive pouring of concrete, large pieces of rock were embedded in the concrete at the finish of each pouring. Each partially set batch of concrete was thoroughly wetted down before the next pouring.

For shifting the concrete forms, handling the rock and overburden at the base of each buttress, and also for dirt filling between buttresses, the Lidgerwood Traveling Hoist, shown in Fig. 11, was employed. The object of the dirt filling is not only to lend additional support to the concrete structure, but also to eliminate the opportunity for freezing and spalling during cold weather.

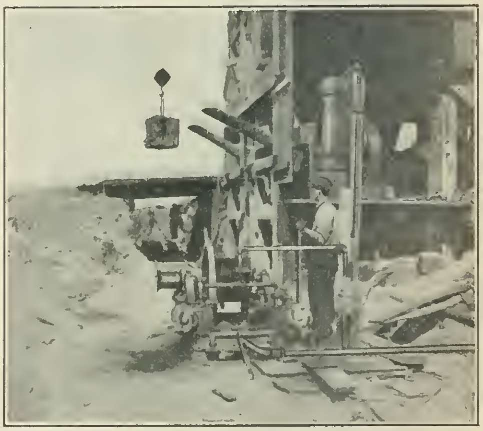


FIG. 11.

The concrete plant, comprising two 1 cu. yd. steam engine driven Ransome concrete mixers, is located at the western end of the work. All materials are supplied to the mixer at the top by means of a Lidgerwood Boom Derrick and Clam Shell Bucket.

A unique feature of this portion of the installation is the manner in which the concrete is conveyed to the Lidgerwood Cable Way which serves the dam. Fig. 12 is a general view overlooking the dam, taken from one of the cable way towers.

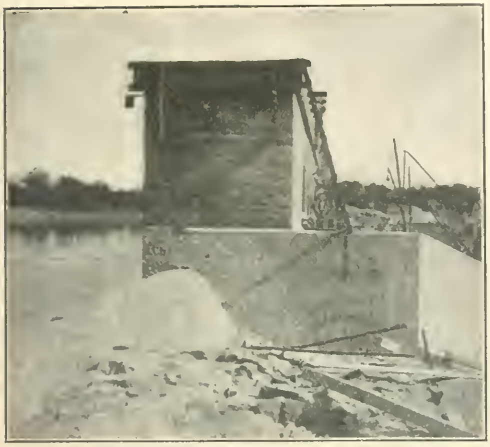


FIG. 12.

A smaller steam operated winch carrying an endless cable hauls a flat car back and forth on a track placed at right angles with the cable way and parallel with the concrete mixer dumping chutes. Hand operated square dumping buckets are placed on this flat car and run in under the chutes. One is filled and returned to the dam where the cable-way traveler picks it up and conveys it to the point of deposit. In the meantime the other bucket is being filled.

The concrete mixture is as follows:

1 2½. 4½ for the top.

1 3, 5 for the buttresses.

All materials for the concrete are hauled in by four 5-ton locomotive trucks. Two of these trucks are equipped with power self-dumping bodies, the other two with hinged bodies, which are dumped by means of the derrick serving the mixers.

The company operates its own Trap Rock Quarry, situated about 2 miles from the dam. The trap rock, which is of a particularly hard, stubborn nature, full of cleavages and therefore presenting unusually difficult drilling, is excavated by means of three D-24 Sergeant Steam Drills. The average drill hole footage is low and gives a fairly good idea of the character of the rock; 12 ft. per day per drill operated by 2 men.

A No. 5 McCully-Gyratory Crusher installed at the quarry crushes all the rock, the straight run of crusher material larger than ⅜ in. being used in the mixers; none of it, however, runs larger than 2½ in.

Considerable preparatory work had to be done before actual work started at the dam. It was necessary to build new and higher roads to replace those which would become inundated by the enlarged reservoir, to say nothing of the grading of certain portions of the reservoir banks and the clearing of the new land. Holt Gasoline Tractor being called into service for pulling tree stumps, etc.

The work is being done by the water company itself, known as the Bridgeport Hydraulic Co., under the supervision of its own engineers. Mr. S. P. Senior, Vice-President of the Company, is Chief Engineer, Mr. W. C. Pollitt is Engineer in charge of the work, and Mr. A. B. Hill, the Consulting Engineer.—*Engineering News, with additions by the writer.*

WAR SCRAP

It looks, on the surface of things, as if the battle-scarred farms around Verdun and other contested districts of the European war might be devoted more profitably to mining than to agriculture, upon the conclusion of peace. The statement has been made that as many as a million shells a day were fired for many days in succession by the Allies in France alone. This, of course, is above the average, but it does not take into account the outpouring of steel from the big guns of Germany.

Let us assume that the average was a million shells per week, from each of the contesting sides, on the area in front of Verdun. The fight raged for some thirty weeks; on this basis, therefore, some sixty million shells were thrown. Calling the average weight per shell one hundred pounds, this means that a total of three million tons of steel were thrown upon a disputed area of, say, one hundred square miles, sixty-four thousand acres, which steel is now somewhere under the surface of the ground. According to these figures, the average weight of steel per acre is about forty-seven tons, worth, as scrap, perhaps twenty dollars per ton.

Add to these estimates, which, of course, are largely guess work, the enormous tonnage of barbwire entanglements, construction steel and other wasted material of war and we have a metal value far exceeding the purchasing value of the land. It might cost more to recover much of this steel than it would be worth in the market; nevertheless, it is unthinkable that the thrifty Eureopeans will not recover a great deal of this scrap when the warring nations finally get through with their "scrapping."

THE AIR PROBLEM IN ICE MANUFACTURE

The principal method of manufacturing ice at the present time is by what is known as the "raw-water system." When the manufacture of ice was begun as a commercial proposition and for many years thereafter it was considered essential to use nothing but carefully distilled water. This was not only for the purpose of producing pure ice but also ice that would look right. If untreated water is converted into ice the air which is always present in the water gives the ice the appearance of frozen snow, and "snow ice" is always objected to.

By elaborate distillation the greater part of this air may be eliminated. This entails the turning of water into steam and reboiling it. For the purpose of economy it is the custom to operate an ice plant with a steam engine and use the exhaust steam from this engine for producing the distilled water. Such a practice meant that the lubricating oil in the engine cylinder would come in contact with the steam, and one of the first steps in the distillation is grease separation to remove this oil. As a matter of fact, a great deal of difficulty is experienced in the eliminating of all such oil and foreign matter.

The elaborate distillation and filtration of the water to be frozen is responsible for the flat, insipid taste of hygienic ice. The frequent claim that ammonia finds its way into the ice can also be attributed to lubricating oil or other substances, which are often found in the frozen product.

The demand for a product which would be more like natural ice in its taste and odor, and at the same time be free from dirt and impurities, has brought about a radical change. As is generally known, ice is produced in rectangular cans or forms. By suspending a tube or other similar arrangement in these cans, through which air at suitable pressure is discharged, the water in the ice cans is kept in a constant state of agitation, and this causes all of the air bubbles to rise to the top and dissipate themselves in the atmosphere. The result is a clear, transparent block of ice, made from pure natural water, without unusual taste or odor, and on the whole is far more satisfactory than hygienic distilled water ice.

Of course, the water used must be pure, and if it contains any dirt or foreign matter, good filters are necessary. Practically every raw plant is so equipped.

The demand for a better product is one reason for the change. Perhaps a more important reason is the fact that the necessity for a large amount of steam is avoided. This makes it possible to use oil engines, electric motors or highly economical steam engines, which would not have enough exhaust steam for a distilled-water plant. In other words, a raw-water plant may be operated at a much cheaper cost. For example, an old-style icemaking plant, to produce 50 tons of hygienic distilled water ice every day of 24 hours, would use in the neighborhood of 10 tons of coal. Let us suppose that this coal would cost $4 per ton. This would mean $40 per day, or 80 cents per ton of ice manufactured.

It is quite possible to operate a raw-water ice plant, driven by a una-flow steam engine, and produce the same amount of ice with about three tons of coal, or a daily fuel cost of $12, which equals 24 cents per ton.

SPEEDING-UP THE COMPRESSORS

Another great stride in advance has been made possible in ice and refrigerating machines by the perfection of what might be termed "high-speed ammonia compressors." The compressor, being the most vital part of an ice machine, has always been very carefully designed, and for 30 or 40 years a speed of 70 or 80 revolutions per minute has been considered the maximum. Many of the machines of the older types ran at not more than 40 or 50 revolutions per minute. Owing to this relatively low speed the use of oil engines or other economical forms of prime movers always meant the adoption of rope or belt drive or some other form of indirect transmission. In small plants rope or belt transmission may be without any great difficulty, but in large plants, especially where oil engines supply the power, such transmission is a great source of trouble and annoyance. The ropes or belts wear rapidly and sometimes break, causing damage and danger to life and limb. Moreover, they are a source of power loss. This amounts to 10 to 20 per cent. of all the power transmitted.

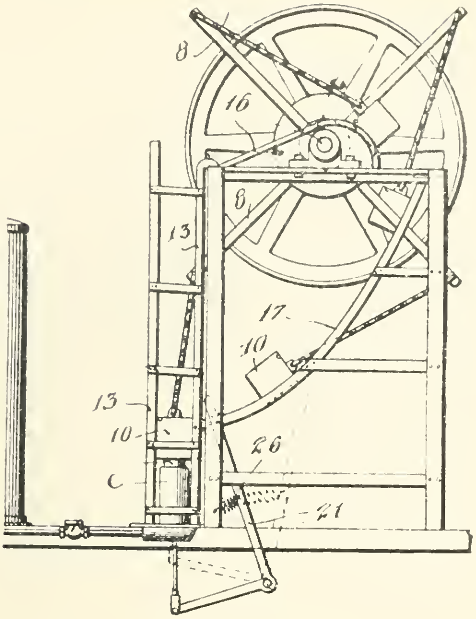
In a 500-horse-power plant a 15 per cent. loss might easily mean over $3,000 or $4,000 a year. About 18 months ago a horizontal ammonia compressor of the high-speed variety was perfected, and now there are 15 or 20 large units in actual operation. These machines are direct connected to oil engines, electric motors and una-flow steam engines. They operate at from 125 to 250 revolutions per minute. The design is such that less vibration occurs than in the old types of machines. Thorough and automatic lubrication is insured by special oiling systems, and the new cylinders need very little attention. Of course, the valves are of unusual design, being of the plate variety, which have been used so successfully in air compressor work.

It seems quite safe to say that in a comparatively short time the ice machine which runs at only 50 or 75 revolutions per minute will be out of date, because it will prove higher in first cost, necessitate more foundation and building space and be less economical. A belt-driven slow-speed machine might need a space 60 feet long, whereas a direct-connected high-speed equipment could be placed in a space not more than 20 or 25 feet long. The engine-room equipment of a 100-ton oil-engine-driven icemaking plant using rope or belt drive would occupy a space of about 60 feet long and 50 feet wide. With a direct-connected high-speed compressor arrangement the space would be reduced to 30 feet in width. —*Robert P. Kehoe, in Manufacturers Record.* (Condensed extract).

AN INGENIOUS AIR COMPRESSOR

The cut above is reproduced from a recently issued U. S. patent. It illustrates how far afield erratic ingenuity can go to accomplish a simple operation. As the specification reads the purpose of the invention is "to generally improve and simplify the construction and operation of air compressors so as to render them more practical, reliable, effective and efficient in operation and less expensive to manufacture and operate."

Any one can easily see how the thing is meant to work. Whether such a thing has ever actually worked we have some doubts. The side of a vertical air receiver is seen at the left. There is a single acting upright compressing cylinder at *C* with the piston normally at the upper limit of its travel. Across the top of the frame there is a horizontal shaft driven by belt or otherwise, and on this shaft there are four long arms *8* to the end of each of which is attached a chain and to each chain a heavy weight *10*. By the continuous rotation of the shaft the weights are successively drawn up the inclined curved slide *17*, then over the curved slide *16* until vertical guides *13* are reached. Then the weight drops freely between these guides, strikes the top of the compressor piston with a whang, the air contained in the cylinder is compressed and some of it is driven into the air receiver, this operation being repeated continuously.



NOVEL AIR COMPRESSOR.

After a weight has dropped, leaving it on top of the piston as shown, it is drawn up slide *17* again, and so on. As it begins its travel up this slide it comes in contact with the arm of a bellcrank lever *21*, pushing it over to position shown by the dotted lines, this movement raising the piston in the cylinder with the thrust of spring *26* to hold it there until the next weight drops.

Tenders for the construction of 148 aeroplanes for the American army which were recently opened showed a remarkable diversity in prices and climbing ability. The prices varied between $12,000 and $30,000 each. The highest speed guaranteed was 90 miles per hour, and the lowest 65 miles per hour. As regards climbing ability the best offered was 6,500 ft. in ten minutes, and the lowest 2,000 ft. in the same time.

PNEUMATIC GRAIN ELEVATORS AND CONVEYORS

At a recent meeting of the Manchester Association of Engineers a paper was presented by Mr. Cecil Bentham on Pneumatic Grain Handling Appliances. The Engineer, London, reports as follows:

He said that as we in this country were largely dependent on imported grain for many necessities in addition to our daily bread, this fact, together with the importance of discharging ships quickly and economically, made this problem of the first importance to the nation. The purposes to which grain elevating plants are applied were divided into the following three heads: (1) Discharging ships either to quay or to barges. (2) Discharging barges at mills or granaries. (3) Conveying grain long distances. The method of conveying the grain is to create a partial vacuum in a receiving chamber by means of an exhauster or pump; the air rushing along the conveying pipe carries with it a stream of grain from a nozzle at the free end of the pipe line depositing it in the receiving chamber at the other end. The grain is then discharged from the receiving chamber by means of some form of valve and is afterwards dealt with mechanically.

The advantages of using a pneumatic plant in the first two methods mentioned, namely, for discharging ships or barges, were enumerated as follows: (*a*) The amount of labor is considerably reduced as compared with any other means of discharging grain, this being due to the fact that a pneumatic pipe will pick up nearly all the grain from the floor of the ship or barge without being "trimmed," as is necessary in the case of bucket elevators, grabs, etc. This avoids the necessity of engaging a large number of casual men when a cargo is being discharged. (*b*) It is healthier for the men engaged in discharging grain with pneumatic plants than with bucket elevators or other mechanical appliances. All grain contains dust varying in quantity and composition according to the condition or the part of the world in which the grain is produced; with ordinary buckets this dust is stirred up and permeates the atmosphere, and it is then breathed by the men who are working in it. The dust is deleterious to the men, dust from maize especially affecting the eyes. (*c*) By passing the grain through the pipes in a strong current of air it is aspirated, and if the temperature of the grain has risen on the voyage, the effect is to improve its condition. The vacuum is also supposed to kill weevils and mites, though the evidence on this point is not sufficient to form a definite conclusion at present. (*d*) Some amount of dust is also separated from the grain during its passage through the pipes and may be discharged from the plant separately. This separation is taken advantage of in mills where the grain is used, but whilst in transit it is still unfortunately considered necessary to put all the dust back into the grain in order to avoid loss of weight. (*e*) With pneumatic tubes the poop and bunker hatches may be discharged without any special scheming, because it is only necessary to pass the grain pipe down into the hold, and all parts of the hold may be reached even when difficult corners have to be negotiated. Where bucket elevators only are installed it is frequently necessary to discharge these holds entirely by means of hand labor. (*f*) Parcels of grain are sometimes separated by cloths, and in these cases the pneumatic method is the only one except hand labor which entirely obviates the risk of mixing. (*g*) Discharging can proceed in all kinds of weather, as it is only necessary to keep the hatch open sufficiently to operate the pipes. (*h*) The average capacity of a pneumatic plant is near its maximum capacity, whereas with the mechanical plant the average capacity is only a small percentage of the maximum capacity.

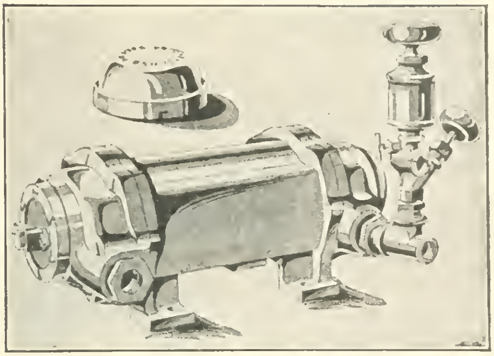
The author then went on to describe one or two typical plants made by the firm of Henry Simon, Limited, the chief features of which have already been dealt with in *The Engineer.* He said that one of the early objections to the use of pneumatic plants was the comparatively large amount of power which was absorbed. In the early plants about 4 horsepower was absorbed per ton of grain per hour handled when discharging ships, whereas now the power is from 1 to 1½ horse-power. For conveying grain considerable distances this power is considerably exceeded, and if mechanical appliances can be used the pneumatic method is not economical for long distance conveying. It, however, frequently happens that there are more or less serious obstructions in the way of introducing mechanical appliances, whereas a single pipe may be taken in any desired direction with very little inconvenience.

The power absorbed by a pneumatic grain-handling plant is extremely large in proportion to the actual work done. In a well designed plant in fairly good condition the mechanical efficiency would only be from 5 per cent. to 6 per cent. This, the author said, was perhaps not a very satisfactory method of stating the power absorbed, because theoretically, no work is done in conveying horizontally, and most pneumatic installations for discharging ships or barges inevitably involve the passing of the grain in a horizontal direction in addition to a vertical direction. If, however, pneumatic plants were compared with purely mechanical appliances, such as bucket elevators, which up to recent years were the most general method of discharging grain, it was found that the power absorbed by a pneumatic plant is still comparatively high. On the other hand, the bucket elevator for discharging ships is somewhat complicated, especially where large variations in height have to be dealt with, but when in good condition and working at a maximum capacity, it gives a mechanical efficiency of 50 to 60 per cent., but to obtain an average capacity equal to a pneumatic plant a bucket elevator would require to have a larger maximum capacity with consequent additional running losses.

CLARK COMPRESSED AIR METER

The great need of some means of accurately measuring compressed air in actual use is indisputable. It is not only desirable to measure the output of the compressor as the only sure guarantee of its efficiency but it is equally necessary to measure the air supplied for the driving of individual tools and groups of tools to determine the cost of operation. A reliable meter will also furnish the best evidence at to line leakage or other losses of air.

The cut here presented shows the essential features of the Clark air meter recently placed upon the market by the Denver Rock Drill Manufacturing Company. This is a positive displacement meter and no air can get through it without actually occupying the cylinder space and being duly recorded. Referring to the cut, the air enters the meter through the nozzle at the right hand end and leaves the meter at the left hand end passing on to drill or other tool which is being operated. In the passage of the air through the meter it forces a piston full stroke back and forth in the cylinder, so that the volume of the cylinder multiplied by the number of strokes gives the quantity of air that has passed. The strokes are automatically recorded by a simple counter at the left hand end, the cover of this being removed and shown in the cut above the meter. In connection with the reading of the meter, the temperature and the pressure of the air, a simple calculation gives the free-air record.



CLARK AIR METER.

The meter as shown is made in one size only, capable of accurately measuring any quantity of free air up to 200 cu. ft. per min., this being sufficient for the operating of any drill or other machine about a mine. Generally speaking, the meter is intended to be placed close to the machine whose air consumption is being tested and to which it is attached in series by suitable short connections in such a manner that the air passes through the meter and is recorded before actually doing its work.

SOME MINING TRUTHS

If mining were as simple as the uninitiated would have us believe, all that would be necessary would be to shoulder a pick and shovel, hammer, drills and powder and a plentiful supply of provisions, and go forth and dig a hole in the ground, extract the wealth therefrom and come home rich. At least that resembles some of the pictures so often presented by eastern promoters in prospectuses calculated to sell mines of questionable worth.

In the early days of mining in any region the pioneers were the prospectors who learned what they know about ores and ore occurrence by direct observation or associations. Their knowledge, which sometimes appears to be instinctive, is not all that is necessary to make a good mining man. They have done and are doing a good work, however, and it is the results of their explorations that usually determine whether or not a region is worth while as a mining possibility.

There have been mines so rich that they could be operated at a profit even by people who were practically ignorant of mining matters. Such mines are, however, rare and there are at the present time few that will yield up their mineral wealth to advantage except under competent direction, for mining has arrived at such a stage that it is a science. It is, in fact, even more than that; it is a combination of many sciences in the application of which many practical points must be taken into consideration, some of them involving great difficulties.

There was a time, when mining was a comparatively simple business, in the conduct of which no special training, other than a little practical experience, seemed to be required. That time, however, is now long past and mining, except in rare cases, can be profitably carried on only under the direction of men who have been broadly educated in the many branches of theoretical and applied science that have now become essential to the successful conduct of mining operations. These conditions have evolved the mining engineer of today, whose advice is as necessary in mining as that of the doctor to the sick man or of the lawyer in business.

And then, too, mining has become a complicated industry and is being carried on upon a grander scale than was dreamed of even a generation ago. This rapid development has involved the development of many industries directly dependent on mining, and in which there is sharp competition. As a consequence, every means to bring mining and its allied industries to a scientific and business-like basis has been made use of.

NEW ICE MAKING PROCESS

A new process of making raw water ice has recently been patented. With this process the refrigerant is a neutral gas or air of suitable temperature which constitutes an atmosphere into which water is conducted in such a manner that the water is formed into ice. According to one method the water, which is preferably pre-cooled, is supplied in the form of a sheet that initially flows down a surface which may or may not be cooled by brine circulating in contact with the rear side, and directed toward this surface is a blast of the refrigerant gas or air which freezes the water, and as the flow of water and the current of refrigerant are maintained, the ice progressively builds up until the desired thickness is obtained. The refrigerant gas or air at no time acts through a film or body of ice to abstract heat from the water, as in the present can and plate systems, but interposed between the body of ice and the refrigerant is a film of water which, in part at least, freezes on the already formed ice. The advantage claimed for this process is that ice can be built up at the rate of from 1/8 to 1/4 inch per minute, so that a block 12 inches in thickness can be produced in an hour or two as compared with 36 to 40 hours with the can method.

INCREASING USE OF MOLDING MACHINES IN ENGLISH FOUNDRIES

Molding machines, which, as we know, are mostly pneumatic, are coming into their own in English foundries. At a recent meeting of the Sheffield branch of the British Foundrymen's Association the following resolution was adopted: "As the foundry trade will have to be prepared for the period after the war, when it will be necessary to reduce the cost of production to compensate for increased wages, etc., it is essential that the subject of the application of molding machines should be fully discussed throughout the country and with this object in view, the various branches of our association should endeavor to secure the services of lecturers who are competent to discuss the subject from an impartial standpoint. It is hoped that the parent association will give every encouragement for the discussion of this topic and we feel that it is to the best interests of all concerned that this course be pursued."

ATMOSPHERIC HUMIDITY TABLE

The table upon the opposite page is reproduced from Bulletin No. 250, "Washing and Cooling Air for Steam Turbine Generators," just issued by Sprag Engineering Company, 93 Federal Street, Boston. The table, which is copyrighted by the above company, is entirely self explanatory and should be valuable for preservation and reference. The material embodied in the bulletin has been carefully prepared, is handsomely presented and should be a welcome acquisition to those who apply for it.

Dry Bulb Temperature Degrees Fahr.	RELATIVE HUMIDITY, PER CENT (PRESSURE 30.0 INCHES)														
	25	30	35	40	45	50	55	60	65	70	75	80	85	90	100
	WET BULB TEMPERATURE DEGREES FAHR.														
60	44.9 .207	46.0 .248	46.9 .290	48.4 .331	49.4 .372	50.5 .414	51.5 .455	52.5 .496	53.5 .538	54.5 .579	55.5 .620	56.4 .662	57.4 .704	58.4 .745	60.0 .828
65	48.5 .245	49.8 .294	51.0 .343	52.3 .391	53.3 .440	54.5 .489	55.8 .538	56.8 .587	57.8 .636	59.0 .684	60.0 .733	61.0 .782	62.0 .831	63.0 .879	65.0 .977
70	52.0 .286	53.3 .344	54.8 .401	56.0 .460	57.3 .517	58.8 .573	60.0 .632	61.3 .689	62.3 .746	63.5 .803	64.6 .861	65.8 .919	66.8 .976	68.0 1.034	70.0 1.148
75	55.3 .337	57.0 .403	58.5 .471	60.0 .538	61.5 .605	62.8 .672	64.3 .740	65.5 .807	66.8 .875	68.0 .942	69.3 1.009	70.5 1.078	71.8 1.145	72.8 1.212	75.0 1.346
80	58.8 .393	60.5 .471	62.0 .549	63.8 .628	65.5 .707	67.0 .786	68.5 .863	69.8 .943	71.3 1.021	72.5 1.100	74.0 1.178	75.3 1.255	76.5 1.334	77.8 1.414	80.0 1.570
85	62.2 .458	64.0 .550	65.8 .642	67.7 .733	69.5 .824	71.0 .916	72.5 1.007	74.1 1.099	75.6 1.191	77.3 1.282	78.6 1.374	80.0 1.466	81.2 1.557	82.4 1.649	85.0 1.832
90	65.5 .533	67.5 .639	69.5 .746	71.5 .852	73.5 .959	75.0 1.066	76.5 1.172	78.4 1.279	80.0 1.385	82.0 1.492	83.2 1.598	84.8 1.705	86.0 1.811	87.2 1.918	90.0 2.131
95	69.0 .618	71.3 .741	73.3 .864	75.5 .988	77.5 1.111	79.3 1.235	81.0 1.358	82.8 1.481	84.5 1.605	86.5 1.729	87.9 1.851	89.3 1.976	90.8 2.098	92.2 2.221	95.0 2.469
100	72.5 .718	75.0 .855	77.0 .998	79.5 1.140	81.5 1.282	83.5 1.425	85.5 1.568	87.2 1.711	89.0 1.853	91.0 1.996	92.5 2.138	94.0 2.281	95.5 2.424	97.2 2.566	100.0 2.851
105	75.8 .821	78.5 .985	80.8 1.149	83.3 1.313	85.5 1.477	87.8 1.641	89.8 1.805	91.6 1.969	93.5 2.133	95.5 2.298	97.3 2.462	98.7 2.625	100.4 2.790	102.1 2.954	105.0 3.282
110	79.0 .942	82.0 1.129	84.5 1.317	87.0 1.506	89.5 1.694	92.0 1.883	94.0 2.071	96.0 2.260	98.0 2.448	100.0 2.636	102.0 2.825	103.5 3.014	105.2 3.201	107.0 3.390	110.0 3.766
115	82.5 1.078	85.8 1.294	88.6 1.509	91.0 1.725	93.8 1.940	96.3 2.156	98.5 2.371	100.5 2.587	102.5 2.803	104.6 3.018	106.6 3.234	108.2 3.450	110.1 3.665	111.9 3.881	115.0 4.312
120	86.0 1.231	89.5 1.477	92.5 1.723	95.0 1.970	98.0 2.216	100.5 2.462	103.0 2.708	105.0 2.955	107.0 3.201	109.2 3.449	111.2 3.693	113.0 3.939	115.0 4.186	116.8 4.432	120.0 4.924

THE OLD AND THE NEW IN ROCK DRILLS AND IN MINING PRACTICE

BY LETSON BALLIET

The question as to whether it would be profitable to discard the old type of piston drills in the Buckeye Mines of Tonopah, and to replace them with new and more modern drills, came up for decision during the summer of 1916.

We had an ideal opportunity for making a positive test. At one of our shafts, there was in operation one piston drill. This drill was driving a long cross-cut to make an air connection with the workings of another property. We had a long record of what this piston drill had done, together with its cost of operation, because there was nothing else being done through this shaft, and this was the only drill at work. The drill was supplied with air by a compressor that furnished air for no other purpose than to operate this drill and run a Leyner drill sharpener that was used only when the steel for this drill had to be sharpened.

This piston drill, a Sullivan F. F., 12 size 2⅝ in. piston, had cost $168 at the factory, plus freight to Tonopah, exclusive of bar, column, arm and saddle. There were about 500 lbs. of steel supplied for the use of this drill, because the company had plenty at the other properties, and was not running on short allowance of steel anywhere. This steel, made up, had cost the company about 15 cts. a lb. at the mine. The discarding of this machine meant throwing $75 worth of steel and a $168 machine into the scrap heap (totaling about $250, including the freight on the machine) and replacing the machine with a new one, together with new steel.

The Denver Rock Drill Co. sent us a hammer drill, which we were to test, and to pay for if the test proved satisfactory. This new Denver Dreadnaught, Model 60, cost $275, plus freight, water tank, extra hose, hose fittings and new steel, which brought the total cost of the new equipment up to exactly $400. Thus the question came down to dollars and cents: "Can we scrap $250 in old material, and spend $400 to replace it with new?"

Our piston machine record was higher in efficiency than those at any other mine from which we had been able to obtain any records, and showed as per Table 1.

TABLE I. PISTON DRILL—OPERATING TIME.

Time setting up	82 min.	17% of 8-hr. shift
Shifting machines	66 min.	14% of 8-hr. shift
Changing steel	75 min.	15% of 8-hr. shift
Lunch.		
Morning and noon starting......	24 min.	5% of 8-hr. shift
Oiling and cleaning............	15 min.	3% of 8-hr. shift
Getting steel and water.........	15 min.	3% of 8-hr. shift
Tearing down and blasting......	45 min.	9% of 8-hr. shift
Actual time piston motion......	158 min.	34% of 8-hr. shift
Total of 8 hrs. equals.........	480 min.	100%

Note.—There were many variations from the above figures at times, but these figures are the average of a year's work upon piston drill mounted on a drill column, with the mucker helping with the setup, and one man running the machine after the setup. The air compressor, with this one drill working, was not started until the setup was made, and was stopped when drilling was finished. Thus 82 minutes of setup time and 45 minutes of loading and blasting time were saved on the compressor power. Compressor running averaged 5 hours and 53 minutes per 8-hour shift. Compressor stopped for 30 minutes at lunch time.

This work was carried on with two shifts at work. The mucker came on shift at 7 a. m., took half an hour for lunch, and was supposed to be practically cleaned up by 1.30 p. m. The machine driller came on at 1.30 p. m., the mucker helped him with the set up and quit at 3.30. The driller took half an hour for supper and finished his shift at 10 p. m., after having blasted his round of holes. The mine was idle from 10 p. m. until the mucker returned at 7 a. m. the following morning.

The hoist engineer was a blacksmith and sharpened the steel upon the drilling shift, as he had no hoisting to do, except to lower the drill man and hoist the mucker. The hoisting was done in a self-dumping skip, and a top man emptied the bin and built the dump.

This work required five men: One driller, one mucker and two hoist runners, one of whom was a blacksmith, and a top man. The pay was $5 a day for each man except the top man who received $4 a day.

The labor expense of this work was $24 a day. The compressor was in motion 5 hours and 53 minutes at a cost of 80 cts. per hour, or $4.71 per day (average for the month including the drill sharpening). The average progress of the best month was 4 ft. per day in advancing the face. The piston drill put in an average of nine holes to break the round, seldom ten, and several times but eight—depending upon conditions. The average amount of powder was about 65 sticks of 40% dynamite, 1⅛ by 8 in. During the month 163 pieces of drill steel were sharpened in the sharpener.

TABLE 2. DRILLING EFFICIENCIES.

Time for first set-up..........	*102 min.	21.25% of 8-hr. shift
Compressor running	130 min.	27.10% of 8-hr. shift
Lowering bar and mucking back	*89 min.	18.50% of 8-hr. shift
*Lunch.		
Compressor run on second set-up :........................	45 min.	9.40% of 8-hr. shift
Tear down and blast..........	*54 min.	11.25% of 8-hr. shift
Total working time (7 hrs.)...	420 min.	87.50% of 8-hr. shift
Overhead costs for (1 hr.).....	60 min.	12.50% of 8-hr. shift

Advanced the face 4 ft. and 4 ins. per shift.

*Compressor stopped during these periods.

This was the record that the new hammer drill must beat. The odds were slightly against the drill in the fact that it was further away from the shaft. The air line was growing longer each month, as well as the tramming distance. There were 1,200 ft. to tram when the drill began, which necessitated two muckers. One mucker rightfully should have been charged up to "distance of tramming," and not to the drill expense. Otherwise conditions were the same for the work. Air was made by the same compressor; the same blacksmith sharpened the steel, and the same men operated the drill that had operated the piston machine

On account of the hammer drill being a faster cutting drill, a change was made in the work. Three men were put underground: One drill runner and two muckers. One hoist runner and one top man were maintained, and all the work was done in one 8-hour shift.

The set up was made on a cross bar instead of on a column. The first set up by the driller with the help of one of the muckers was on top of the muck pile. The other mucker began the work of moving the muck from under the driller, and when the drill was set up the mucker, who had helped with the set up, took another car and alternated with the first mucker by loading his car, while the other made a trip to the shaft and returned. In this way, by the time the driller had finished his holes from the first set up, the muckers were supposed to be cleaned out enough to allow the bar to be lowered for the second set up; if not, the driller "shoveled back" and one of the muckers helped him lower the bar.

Thus it will be seen that with the hammer drill the heading was advanced 11 ft. further in 31 days than with the piston drill, and it was in use only 7 hours per day, saving 12½% of the overhead costs per shift.

The ventilating fans ran 7½ hours per day instead of 15 hours as with the over-lapping shifts, and there were 7 hours of lighting the underground against 15 hours during overlapping shifts. The men were paid the same for 7 hours' work as had previously been paid for 8 hours, so there was nothing saved in labor costs, but the same 5 men accomplished 9% more progress by driving the crosscut a greater distance in 31 shifts for the same amount of wages that had been accomplished in 14½ hours a day for 31 days (62 over-lapping shifts). Thus they saved 52% of the overhead time.

The ventilation was done by means of a small centrifugal blower driven by a motor. Electric power was purchased from the Nevada California Power Co. at the rate of 4 cts. per kwh. The blower cost 4 cts. per hour to operate.

Electric lighting in the mine and on the surface during the night shift, made a difference of about $4.50 a month. This was computed by the hours the lights burned and the size of the globes, as the lighting was on a 440-volt circuit, with four lights in series (not a particularly desirable way of lighting, but it saved considerable expense in wiring a separate lighting circuit, while this work was being done), and was included on the 440-volt meters.

The compressor cost 80 cts. per hour while carrying the piston drill, and 60 cts. per hour while carrying the hammer drill, owing to the fact that the piston drill required more air than the hammer drill. Much of the effectiveness of the piston drill was lost by the friction of the steel working forward and back in the drill hole. This also wore down the gauge of the drill bits, which required much more steel to be sent to the blacksmith to be sharpened and re-gauged.

During 31 days of 62 over-lapping shifts, the piston drill required the compressor to furnish air for 182 hours and 23 minutes, including that which was required in the shop to sharpen 163 pieces of steel. Power for running the compressor cost, at 80 cts. per hour, $145.91 for the month.

The hammer drill running 31 days required the compressor to be running 2 hours and 55 minutes a day, or 90½ hours in 31 days, and at 60 cts. per hour cost $54.30 for power, including 34 pieces of steel sharpened in the shop. This showed a saving of $91.51 in power on the compressor.

Although the hoist engineer sharpened the steel, in this case we must compute his time at $5 per day, and take such part of his time as he was engaged in sharpening steel and charge it to that item. On this basis we find that the piston steel cost us about 20 cts. per bit sharpened, including the building of the forge fire, heating, sharpening and tempering.

The hammer drill, on account of its rapid drilling, and ease of changing steel without the chuck nuts to work with, allowed the driller to put in an average of eleven holes to break the round; occasionally twelve; and all a little deeper than the piston machine holes. This was not directed by executive order, but was done by the driller who would rather put in an extra hole or two than to get down and "muck back," as it allowed the muckers to clean up a little closer for him.

This doubtless meant a little extra time of compressor running, a little more wear on the steel, and a few more pieces of steel to be sharpened in the shop. It required two more lengths of fuse and two extra blasting caps, but this was more than made up because the driller used from seven to ten fewer sticks of powder each day, by loading the bottoms of the holes and tamping heavier on top. Thus, these extra holes saved about 120 lbs. of powder which was costing us $19 per hundred pounds.

Being unable to determine what the power bill would have been with two less holes, except by the cost per foot of drill hole, we disregarded the item of "powder saving" as balanced against extra fuse, caps, power and drill sharpening. But these extra holes and increase in depth, netted us 11 ft. more progress with the crosscut in 31 days than the piston drill delivered.

With a labor expense of $744, the piston machine delivered 124 ft. of progress at a cost of $6 per foot, and with the same expense the hammer drill delivered 135 ft. at a cost of $5.51 per foot. Eleven feet increase in progress at $6 per foot gave us a net saving of $66.

It is obvious that there was a saving of incidental overhead expense, life of electric globes, wear or depreciation of machinery due to shorter operating hours, etc. But inasmuch as I have figured top labor, blacksmithing, lighting, ventilating and hoist engineer, we will ignore overhead, because the additional 11 ft. of progress required a little more power to hoist the rock excavated from this 11 ft. Thus these items can well be figured as offsetting each other.

If the drill had been nearer to the shaft, so that one mucker could have trammed the muck, there would have been one less man on the pay roll, saving an additional $155, but the long distance to tram from the face to the shaft required two muckers. While we did the same work in one shift that we did in two, we laid off one hoist runner, but sent an extra man underground at the same pay. Thus the total expenditure for labor was the same in both cases.

The fact that the men were able to finish their work in 7 hours instead of 8 worked a moral effect that caused them to do better work, to keep their pipe lines in good shape, to lay their shoveling plates well down so that they wouldn't be bent by the blast, and incidentally did many little things to facilitate their work. As a result we are getting more for our money, making faster progress and the men are working 7-hour shifts for the same pay.

In other places where there would be a different wage scale, or a different power rate in effect, these figures would have to be modified to suit the case, but on an average it is safe to say the modern drills will pay for themselves and the steel in 3 months. If the same steel can be used, replacements of worn-out machines will pay for themselves every 2 months.

We have satisfied ourselves that it does not pay to continue operations with obsolete types of machines.

From this data it was seen that the old piston drill required the air compressor to be running 10,943 minutes (182 hrs., 23 min.), to deliver 1,395 ft. of drill hole, averaging about 1½ ins. of drill hole per minute, during every minute that the compressor was using power.

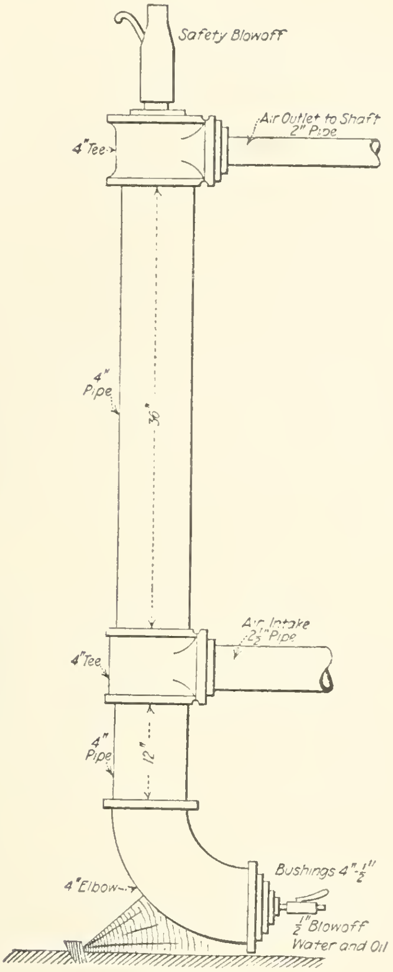
Also it was ascertained that the hammer drill required the compressor to be running only about half as long—5,430 minutes (90½ hours) to deliver 1,736 ft. of drill hole, averaging nearly 4 ins. of drill hole per minute (a foot every 3 minutes) that the compressor was in motion.

HAMMER DRILL PROGRESS

The Monarch Pittsburgh mine, as well as the Buckeye mines, have discarded their piston drills for hammer drills with hollow steel and water feed. The Midway is using Leyner drills of the same type, and several other operators are using some drills of similar design. There are a few managers who think that they cannot afford to scrap their old machines for new on account of the first cost, but it is very evident that their expenses are so much more that they are actually paying out the amount that the new drills would cost every 3 months, and it is only a matter of time when all the obsolete types of drills will be discarded.—*Min. World* (Condensed).

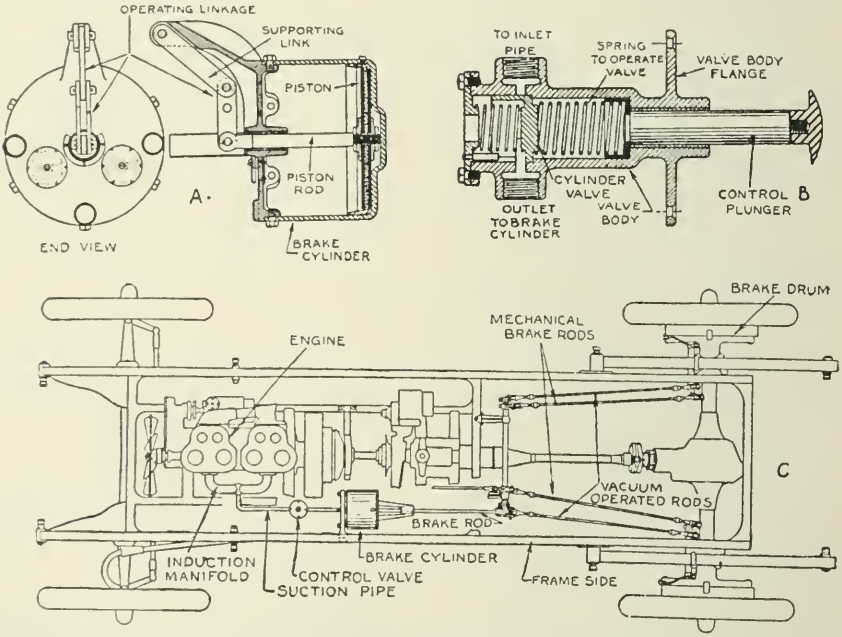
SEPARATOR FOR COMPRESSED AIR LINE

The cut here reproduced from a recent issue of Eng. and Min. Journal, contributed by Mr. J. F. Kellock Brown, Mining Engineer, Sydney, N. S., shows the arrangement devised and applied by him for separating oil and water from the air flowing from the compressor to the drills or other apparatus to be operated. The sketch tells practically everything requisite to be known; Mr. Brown remarking upon it as follows:



DRAINING THE AIR LINE.

The use and care of compressors or mining work is not scientific, the men available for the work are ignorant, and so it frequently happens that oil troubles develop in the machine underground. When you add to that the freezing due to moisture in the air, the value of any kind of apparatus that will help to mitigate these drawbacks in apparent. A separator should of course go along with every compressor, but we all know what prospecting outfits are; there is always something that should be there but never is sent, and a separator on the air line is one of the things frequently conspicuous by its absence. Usually there is nothing available from which to make one. This at least was the case on the work where the separator described was used. Its construction will readily be understood from the illustration, pipe and fittings being all that is required. The air intake from the compressor was a 2-in. line and the outlet 2½-in. The separator itself consisted of 4-in. pipe with the necessary tees and elbows to suit. Above the air exit the 4-in. tee was bushed down to hold a 2-in. safety valve, while the foot of the separator, which ended in an elbow, was also bushed down to hold a ½-in. turn-cock taken from an air drill. By watching and keeping the lower space clear of the collected moisture and oil that came over from the compressor, a great improvement in the quality of the air was obtained.



Vacuum brake system and its parts. A. End and sectional views of the brake cylinder. B. Sectional view of the control valve. C. How the brake system is installed

THE VACUUM OPERATED BRAKE

No one familiar with current mechanical engineering practice will deny that the airbrake so widely used in railroad work is the best form for this purpose and one that makes it possible to control a heavy moving mass with minimum exertion on the part of the operator. The idea of using an airbrake on automobiles is not new, as various modifications of the Westinghouse braking system have been designed and fitted to cars in an experimental way. A new form of brake actuated by vacuum or engine suction has been worked out that makes it easy to control the speed of the largest and heaviest automobile with very little exertion. As it is being marketed by an accessory manufacturer of national reputation after severe tests it is evident that this system of braking should be given some consideration. The idea of the brake operation is the using of suction prevailing in the intake manifold while the engine is running. While the reduction in pressure is but a few pounds per square inch, this may be converted to a useful force by using a piston of large area. The inventor states that a force of about 10 pounds to the square inch is available as a rule and as the diameter of the piston is 7 inches and its effective stroke 4 inches it will be evident that a considerable force for brake actuation is available at the piston-rod. This is joined to a system of reducing levers which reduces the travel of the brake-rod and multiplies the operating force considerably. The construction of the air-brake cylinder, the control valve, and the methods of installing the various units in the frame of a typical automobile are clearly outlined in accompanying illustration.

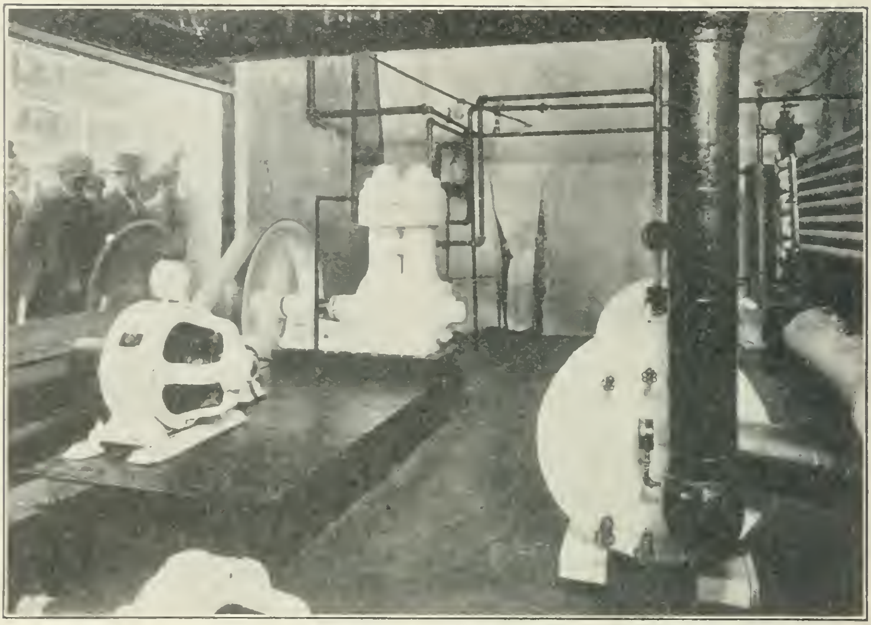
A control valve of a simple construction is interposed in the pipe line joining the intake manifold and the brake piston chamber. This valve may be operated either by hand or foot as is most convenient. The internal construction of the valve is such that the brake may be applied with different degrees of pressure. As the pull on the brake-rod is determined by the depression in the brake cylinder, anything that will lessen or increase this depression will correspondingly alter the braking force. The valve does this automatically. When the control plunger is depressed, this compresses a spring which moves the cylinder valve and provides a passage between the suction pipe and the brake cylinder and also prevents the entrance of air. Just as soon as the pressure back of the valve is reduced, the pressure of the air on the other side forces it up against the spring, closes the suction passage and in this way the amount of vacuum in the brake cylinder is controlled by the degree of movement of the control plunger. The spring is of such strength that if the plunger is fully depressed the valve will not be opened by air pressure. As soon as the operating lever is released the valve cylinder moves back to the position shown in the drawing, cutting off the suction opening and providing a bypass so that the outside air goes into the cylinder, releasing brake.

The cylinder construction is similar to that used in braking railroad trains. The cylinder is of pressed steel and the head is a steel casting. The weight is but 12 pounds. The simple steel piston uses a leather cupped washer packing. As long as the engine is running, or rather turning over, whether the motion is produced by the explosion of gasoline in the cylinders or by the overrunning action of the rear wheels when descending a grade, which of course, drives the engine through the axle driving gears and propeller shaft, a full application of the brakes is possible. The method of installation consists of connecting the brake cylinder to the intake manifold by a length of tubing in which the control valve is interposed. Instead of connecting the brake linkage to a foot pedal or hand lever, it is attached to a link operated by the piston-rod, which is clearly shown in the detailed drawing of the brake cylinder. It is said that sufficient power is obtained to slide the wheels even if the car is running at a speed of but one-half mile per hour. In tests this very slow speed was obtained by driving the car through the medium of the electric starting motor.

SUGAR BEETS MUST BREATHE

It is generally known that sugar beets breathe mainly through their leaves; but it is also true that the soil may play an important part in furnishing oxygen to the plant by way of the roots. It is a recognized fact that with beets, as with all other cultivated crops, it is necessary to have a certain amount of oxygen around the roots. Experts differ as to the office the roots have in the absorption of oxygen; nevertheless, every farmer knows that the roots of all cultivated plants require oxygen around them for their healthy growth. Hence it is essential that the soil shall be so cared for as to permit proper aeration.

The fact that proper cultivation renders the soil capable of admitting oxygen to the roots explains to some extent why the agricultural experts of the various beet sugar companies lay considerable stress on the matter of cultivation. There is another important function of cultivation which must not be overlooked, that the stirring up of the soil permits the escape of noxious gases that are perhaps given off by the beets themselves or are produced by the action of bacteria on the remains or excreta of other plants. All plants are very sentitive to gases, hence it is necessary that these be permitted to escape before they injure the plant. In view of these facts, it is obvious that proper cultivation plays an important part in the building up or the maintenance of soil fertility. In addition to this, ventilation plays an important part in the supplying of oxygen for the purpose of oxidizing the organic matters given off by the beet. Thus we observe that by proper cultivation the plant is not only supplied with oxygen, but that proper ventilation of the soil is brought about and this permits the escape of noxious gases, in addition to furnishing sufficient oxygen to the soil to oxidize the existing organic matters, which might exert considerable influence upon the fertility of the soil.



PORTABLE REFRIGERATING PLANT.

THE HIPPODROME TRAVELING SKATING RINK

The skating on real ice which has been the supreme attraction of the New York Hippodrom for two or three years has proved such a money making feature that it is to be exhibited in duplicate in the other large cities of the country. While it was of course costly there were no great engineering difficulties encountered in staging the ice ballet at the Hippodrome where the show was to run the entire season, but it is quite another thing to transport a skating rink around the country with only a short run in each place.

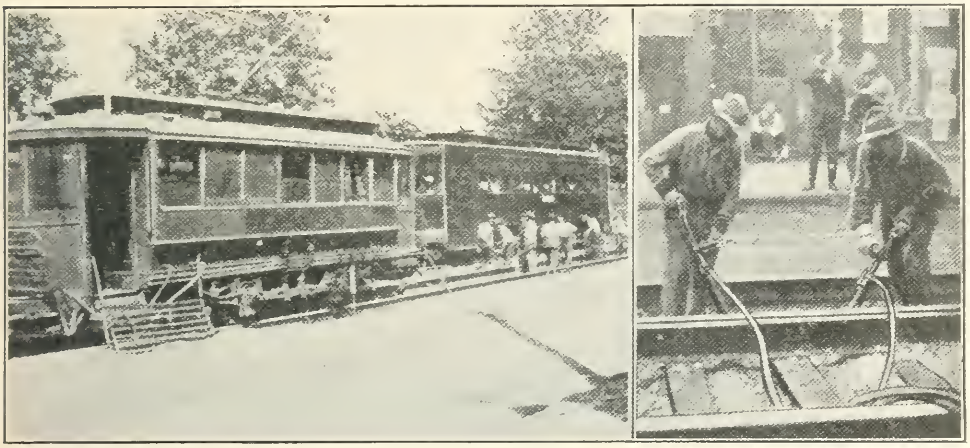
When it was decided that the scheme was practicable and that the entire Hippodrome spectacles of "Around the World" and "Flirting at St. Moritz," the most realistic and brilliant ice ballet ever staged should be shown in many other cities, the ice plant shown by the accompanying half-tone proved a complete and satisfactory solution.

The various units of this plant are transportable, each being mounted on a skid or stand, so that when the show closes at any point it is only necessary to take down the piping, haul the different pieces of apparatus, on a truck, pack them into a car and ship to the next showing place. To prevent the loss of time required to erect the plant and freeze the water, which takes 24 hours, duplicate outfits are used. While one is working in one city the other is being set up at the next point, so that everything is in readiness when the company arrives. The first plant then goes to the succeeding appointment, and so on.

Each plant consists of a 10-ton York compressor, with two cylinders each 6½x6½ inches, driven by a 20 h. p. direct current Westinghouse motor, and a 60 kw. Westinghouse motor generator set. Where direct current is available, the motors are operated from the power circuit, but as usually only alternating current is to be had, the motor generator set is used to transform the alternating current into direct current for the operation of the motors.

The brine tank has a capacity of 1,900 gallons. The ice pond formed on the stage is 45 feet long, 20 feet wide, and 4 inches deep. While being frozen, the water is held in place on the stage by a canvas tub. The ice surface is covered or concealed for the acts which precede the skating.

Two things less than each other must be also reciprocally greater than each other.



TAMPERS AT WORK.

PNEUMATIC TAMPERS CUT LABOR COST IN HALF IN PITTSBURGH

The Pittsburgh Railways was one of the first to use pneumatic tampers. The present equipment consists of two compressors, each of which furnishes power for a battery of six tampers. These machines have three lines, respectively 50 ft., 100 ft. and 150 ft. long, and each line takes care of two tampers.

The company is also planning to purchase five portable sets, made to handle four tampers each, in order to secure the convenience of working with compressor equipment that can be kept off the tracks where traffic is being maintained upon the tracks undergoing repairs.

As in other installations, the pneumatic tampers show a decided saving in cost, the saving per foot of track being about 15 cents, or one-half of the former cost. The proportionate saving in men, however, is greater, and this is an advantage, particularly as the much smaller force that is required is of a higher grade. There is only 30 per cent. of the force used that would be required for hand tamping.

The ballast used in Pittsburgh is classified as "coarse," in which sizes up to 2½ in. are used, and as fine, in which 1 in. is the largest size. The machines tamp both classes of ballast much better than was customary with hand labor. Though the tamping is done as a rule with the 1-in. ballast, the rough ballast is spread, compacted and rolled to a depth of about 6 in. before the track is laid.

The company has also taken advantage of the Ingersoll-Rand tamping equipment to reduce the first cost of Thermit welding outfits. The ordinary preheater used in connection with Thermit joints includes a blower outfit which costs about $600. The Pittsburgh Railways only find it necessary to use of this outfit the tanks and burners, costing about $35, to do the preheating in connection with reduced air pressure supplied from the compressor outfits.

A second incidental advantage of the tamping equipment is the forthcoming use of small air drills, which are lighter than electric drills, in making joints immediately following the tamping. Also, having compressed air on the job, it may be found to be useful to run air drills to break up and remove concrete.—*Electric Railway Journal.*

SOME PRESSURE

Under a pressure of 1,035 pounds per square inch and flowing at a rate of 260,000 barrels a day, a well, known as Cerro Azul No. 4, near Tampico, Mexico, said to be the greatest oil well in the world, was recently brought in by the Mexican Petroleum Company, Ltd. The well casing had been tested to a pressure of 1,050 pounds, which was practically equaled by the pressure registered after the well was closed. The force of the escaping gas under this pressure blew the two-ton drill bit out with it and threw it 125 feet from the well. Its cable became entangled with the valve at the top of the casing and tore the latter off. The drill bit and the escaping oil, which subsequently rose to a measured height of 600 feet, demolished the derrick. It is estimated that 1,000,000 barrels escaped before the flow was shut off.

SUCTION ELEVATORS FOR SMALL COAL

Since Mr. Duckham, the then engineer to the Millwall Dock Company, invented, about thirty years ago, his suction elevator for handling grain, his idea has been further developed, especially in the United States and Germany, not only for the conveyance of grain, but also of ashes, slack, and other small materials. The principal advantage of the pneumatic system—working either by blast or suction or the two combined—is that it gets rid of the dust nuisance which is so distressing to the workers. Some years ago in Hamburg grain elevators for the Hamburg American Line, under the Duckham patents, were built and more recently an installation for the German Solvay Works in Bernburg for unloading lignite slack from railway trucks. This plant handles 15 tons of slack per hour. An iron mast is placed close to the railway siding, from which the suction pipe with a flexible joint is suspended, the height of the pipe being adjustable by a winch. The suction nozzle is guided by a workman, and the slack is raised into a large hopper-bottomed receiver, by the side of which a dust collector is placed, also hopper-bottomed. The exhaust pump is of the vertical type and is connected with the top of the dust collector by piping. Leaving this vessel the air is passed through a filter in order to intercept all fine dust, and then drawn out and ejected by the pump. The slack drops from the hopper into a trough, and is carried to its destination by a spiral conveyor.—*The Engineer,* London.

A JACKHAMER WORLD-RECORD

At the quarry of the Alabama Marble Co., one of the Jackhamer operators put down 100 4 ft. holes in marble in ten hours. This is drilling at the rate of 8 inches each minute of the day's work. The holes are nearly vertical, only a few inches apart, and are used for plug and feather work. With this close spacing the Jackhamers practically never stop. They operate on air supplied at 100-110 pounds pressure.

BARGAINS?

BY BERTON BRALEY

When the smooth-tongued salesman comes around with his talk of some new device,
Which he says is the niftiest thing on earth and worthy of twice its price,
He may be telling the gospel truth as clear as the light of day,
But the wise man mutters behind his hand, "It looks good, but will it pay?"

For the test of a grate, a metering device or recorder of CO_2
Is never its looks or the salesman's talk, but rather what it will do;
So the wise man gazes at plots and prints and hears what the salesmen say,
But quietly figures the costs and sighs, "It looks good, but will it pay?"

Or the man from the central station comes, and a plausible chap is he,
And he wraps himself in a mist of words like a roseate rhapsody;
He would junk your plant, and he'd sign you up on a contract right away,
But the wise man murmurs in accents low, "It looks good, but will it pay?"

Efficiency experts dope things out on the latest and smartest plan,
They count the strokes of each piston rod and the motions of every man;
And they're frequently right in their scheme of things and the logic that they display,
But the wise man nevertheless exclaims, "It looks good, but will it pay?"

Now there's room for progress in every plant, and the mossback's just a fool,
And the man who balks at the thought of change is worse than a stubborn mule;
But the "show me" chap has the right idea and never goes far astray
When he puts each change to the acid test—"It looks good, but will it pay?"—*Power.*

COMPRESSED AIR MAGAZINE

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WHO CAN BEAT IT?—EITHER THE STORY OR THE TELLING OF IT

Grant, Smith & Company recently completed at Senic, Washington, under the supervision of T. Walsh a 2,000 ft. tunnel approximately 20 ft. 6 in. wide by 26 ft. 6 in. high. To complete this tunnel they were required to remove 790 ft. of open cut rock to the outside faces, also build an adit 245 ft. and a small cut 88 ft., which gave them six working faces. Part of the mucking was done by steam shovels and the balance by hand, and horses were used to pull the muck cars.

They finished this work in exactly six months, working two ten-hour shifts a day, except Sundays when only light work was done. The air equipment consisted of one Ingersoll-Rand "AC" Compressor and one Rand "Type X" Steam Driven Compressor, twelve "C-110" Drills, eleven "Jackhamers," one wet "Jackhamer," five No. 18 Leyners, four 3¼ in. Piston Drills, five "BC-21" Stoping Drills, and a few other older drills. They made no attempt at speed except to finish the work in six months, as originally contemplated. In checking over their record they really did accomplish fast work, doing about a foot an hour per every hour worked. The rock was very seamy, and to start some of the faces a small pioneer tunnel was built and then worked back to the face, so as not to have the rock come down. Five hundred and thirty feet was timbered. They were also bothered with water and used several pumps.

An interesting part of the work was that 400 ft of the tunnel was driven by one "Jackhamer." This tool did remarkable work for its size.

The No. 18 Leyners had previously driven a 3,000 ft. tunnel in Oregon, and when this job was finished were still in pretty good shape.

F. C. Bruhns.

Seattle, Wash.

The above letter we know will be welcomed by the readers of Compressed Air Magazine for its intrinsic value and importance, and it is especially appreciated by the editorial department as typical of what we are continually pining for. There are compressed air operations and achievements concerning which specific information would be of the greatest interest and profit to our readers, but unfortunately nobody does the telling of it. There are men enough who can tell a straight story when talking to a friend about what has been done or is being done who never think of writing it, when really one is just as easy as the other. Write as you talk. Scribble it off with a lead pencil; pay no attention to spelling, punctuation, sentences, paragraphs or capitals, just give us the facts and as many as possible of them. We will put it in shape and everybody will be benefited.

NEW PRECEDENTS AND INCREASED PROGRESS IN TUNNELING

The adoption of the shield method for construction of a small tunnel in Milwaukee in fairly good ground is one of various recent occurrences that tell of progressive, original activity in the field of tunneling. It is a fact that tunnel construction is among those fields of civil engineering work where marked advance is being made.

Within the past month two compressed-air tunnels of great difficulty were holed through, the Old Slip tunnels under the East River at New York. Various elements contributed to the success, which in the aggregate mean distinct progress in the art. Rapid control of face work, deep and wide blanketing of the river floor, and a highly original void-filling method —"grouting" with gravel by air ejection—are the chief of these elements.

A few months back the completion of the Rogers Pass tunnel, a sound-rock tunnel, signalized the brilliant success of a radically novel method of attack in rock. The system of blasting in rings from a central pilot tunnel, a bold innovation, was the key to success. Though centuries of prior art in rock tunneling were available, sound engineering in this case lay in abandonment of precedent.

Precedent was cast aside similarly in the new Cleveland intake tunnel under Lake Erie, which also was holed through a few weeks ago. The stereotyped form of lining for shield tunnels —cast-iron segments—was dropped, and a lining of concrete blocks was substituted. The economy of this expedient is obvious, iron being costly. But whether a long tunnel, with all its contingencies and hazards, could be built of concrete blocks in successful manner had to be proved by experience.

With new activity thus moving in the field of tunneling, further development is sure to result. As tunnel construction is cheapened and its range of application widened, it will be more frequently applied.—*Engineering News Editorial.*

SAND-HOG DECOMPRESSION REGULATIONS

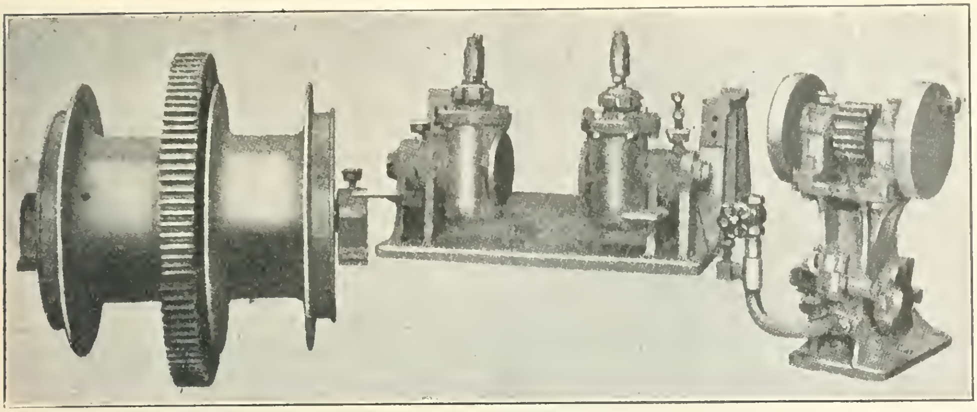
In the harbor siphon tunnels of the new intercepting-sewer system at Milwaukee, Wis., the Western Foundation Co. is carrying on compressed air work under unusually cautious rules. The following times are prescribed for decompression:

For Pressure (Lb.)	Time of Decompression (Min.)
20 to 24	16
25 to 30	20
31 to 36	24

The men are required to dry their clothes and drink hot coffee on coming out of the air, suitable facilities being provided. The two tunnels, worked from a joint shaft on Jones Island, are 52 ft. below river surface, and at present are carrying about 28 lb. air. They are in sand, which stands excellently under the effect of the air, so that open face work is done.

INFLAMMABLE LIMITS OF MIXTURES OF GASOLINE VAPOR AND AIR

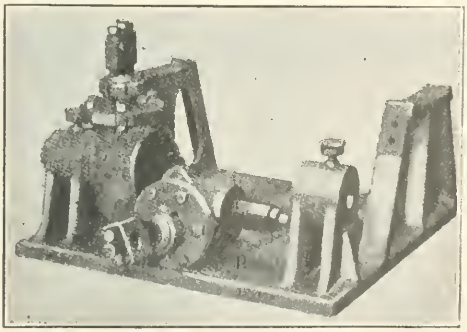
Using a 100 Cc. (6 cu. in.) Kempel explosion pipette, and igniting the mixtures from the top, there was obtained as the lower limit of complete inflammation a value lying between 1.9 and 2.0 per cent. of gasoline vapor. The upper limit under these conditions was found to be between 5.2 and 5.3 per cent. of gasoline vapor. The gasoline used had a specific gravity of 73 deg. Baumè. Under the same conditions, except ignition of the mixtures from the bottom, there was obtained a value lying between 1.5 and 1.6 per cent. of gasoline vapor for the low limit. With the same grade of gasoline, using a 2,800 Cc. (170 cu. in.) vessel and with ignition from the bottom, by means of an electric flash produced by pulling two wires apart through which a current of 7 ampères at 220 volts was flowing, there was obtained a value lying between 1.4 and 1.5 per cent. gasoline vapor. The high limit under these conditions lay between 6.0 and 6.4 per cent. of gasoline vapor. Appreciably different limits were not obtained with cleaners' naphtha.

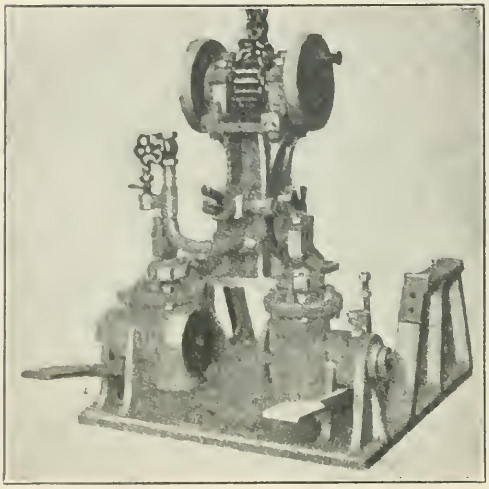


OSCILLATING CYLINDER COMPRESSED AIR HOISTING AND HAULAGE ENGINES

At a meeting of the National (British) Association of Colliery Engineers, North Staffordshire Branch, it was said that in connection with underground haulage, in coal mines, there has been for years a demand—amongst the smaller sizes—for a type of engine of the simplest possible construction, so that it could be handled by unskilled labor, and compact so that it could be moved from place to place with a minimum of difficulty. In view of this, a firm who made a specialty of underground conveyors had introduced an oscillating-cylinder type of engine in order to do away with expensive and complicated link motions. This form of engine, unless carefully designed, is liable to leakage at the port faces, and in order to counteract this tendency means are usually provided to tighten the working faces of the cylinders and air chamber against each other, with the natural result that, to prevent leakage, this degree of tightness is so great as to cause excessive wear and thus defeat its own object. In the engine described this objection has been overcome by carrying the cylinders in separate trunnions, and introducing a reversible valve between the cylinders which is composed of two independent parts kept up to the cylinder faces by means of the air pressure as in an ordinary slide valve.

The engine, as finally approved after test, is of the two-cylinder, double-acting, oscillating type, with the cylinders placed vertically at the front of the machine, the cylinder trunnions being carried on brackets on the bed and to the outside of the cylinders. The port faces of the cylinders face towards the centre of the engine, and between these faces is placed an air chamber, in which is carried the reversing valve, which also serves the purpose of supporting the crankshaft pedestals. The drumshaft is situated behind the engine, and is driven by means of a pinion and spur-wheel, but for endless and main-rope haulage, the drum is placed on the right-hand side. Each drum is fitted with a foot brake and hand-operated clutch. The engine is reversed by a handle placed in a central position in front of the cylinders. The two halves of the reversing valve are each scraped to an air-tight fit on the faces of the cylinders; and, as before mentioned, are kept up to their work by the pressure of the air. Therefore, once this joint is made air-tight, it will remain so for an indefinite period; and, as the exhaust takes place at the port face, a scavenging action is constantly present, which tends to keep the faces clean. This design of valve gives the shortest air ports it is possible to obtain, there-

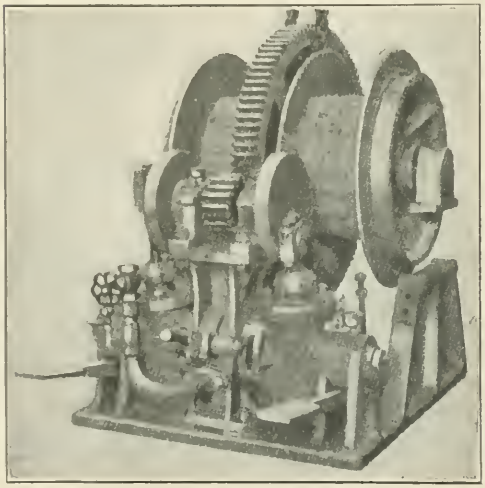




by consuming a minimum of air for a maximum of power; and, as the exhaust takes place through special ducts at the port face immediately into the atmosphere, no freezing can occur. For ease of erection or dismantling the drums are so designed that they can be removed by taking out four bolts, and the other units, such as crankshaft, cylinders and air-chamber, with equal ease.

The engines, which are made in several sizes, have also recently been adopted for driving coal conveyors, and can, of course, be adapted for a variety of other purposes.

The half tones, which through a second reproduction are far from satisfactory to the eye, will still serve to show the essential features of the machine.



AIR HAMMERS IN THE STONE TRADE

The International Cut Stone Contractors' and Quarrymen's Association of North America has been conducting a careful and diligent investigation of the charges made by the officers of the Journeymen Stone Cutters' Association that the air hammer is injurious to the health of the users. Some of the results of the inquiry are reported in the monthly leaflet issued by the association.

Instances have been found where some of the fingers on the hand guiding the hammer show poor circulation, and in freezing weather are more or less sensitive to the cold, but a case of paralysis of the arm, or, as charged, a man being driven insane or incapacitated in any way has not been discovered.

In New York City, where the air hammer is used in the stone industry probably more extensively than in any other city, a complaint has never been recorded against its use, and out of one hundred stonecutters interviewed on the subject during the past three weeks, ninety-seven favored the air hammer. In the Brooklyn Navy Yard the hammer is used very extensively for riveting and chipping, and there has never been a complaint registered against its use.

The structural iron workers use it in the erection of the steel and structural iron work, and the only complaint made by them was that they thought they should receive greater compensation when using the hammer, as they accomplished five times the work with the air hammer as they did by hand. At the works of the New York Ship Building Company at Camden, N. J., there is in use at the present time over one thousand air hammers, and there is no record of any such effect as complained of by the Stone Cutters' Union, and the employees have never made complaint against its use. At these works, as also at the Brooklyn Navy Yard, all riveting, chipping and calking is done with the air hammer, and the hammer used is very much heavier and more powerful than the hammer used by stonecutters and carvers.

The investigation, as far as it has progressed, has found, that where injury to the user of the air hammer has occurred it has been caused by ignorance of its use. If there are any ill effects from the use of the air hammer it is caused by vibration, and the man using the hammer should be educated to hold the hammer in such a manner as to incur as little of the vibration as possible, and he should not try, or be permitted to do work with the air hammer for which it is not adapted.

Mr. James B. Gillie, of the South Dover Marble Company, a gentleman of the widest experience in the stone industry and one who has given a careful study to all the problems of the trade, writes that he has found that the use of the pneumatic hammer has been of great benefit to the trade and of no injury to the employees using the same, provided that the pneumatic hammer is used for the purpose it was intended to be used for, viz.: the finishing or lighter work done in our trade. Personally, I have had experience with the pneumatic hammer since it was first introduced into New York City, about the year 1901. I have seen it used on all kinds of stone used in the construction of buildings. I have personally interviewed men who have used the pneumatic hammer since it was first introduced into New York City, and they agree with me that it has been of great benefit to the trade and of no injury to the employees using it. The only complaint I have heard caused by the use of the hammer was that "sometimes in the winter the hands are cold," but when I asked the question, are the hands any colder when using the pneumatic hammer than they are when using the mallet and chisel, I was informed that there was practically no difference. Like all new inventions, there are apt to be abuses, caused by the improper use of the invention or by neglect of other implements that were used prior to the introduction of this tool. The fact that the pneumatic hammer and the necessary tools for the same are generally furnished by the employer, has given excuse to the employee to neglect the tools that they should furnish, and it is a very frequent sight to see an employee come to work with a mallet that has long outlived its usefulness, and a few tools that are but stumps and should be thrown into the scrap heap or made into plugs.

Another abuse of the pneumatic hammer is allowing apprentice boys to use it before they are thoroughly familiar with the use of the mallet, chisel, hammer, hammer points and pitching tools. The consequence will be that in a very short time new mechanics will be unable to use the tools that have always been deemed essential to the cutting of stone. The pneumatic hammer and tools as an adjunct to the old time honored tools of the stone cutting trade are a very decided improvement, but the fact should be brought forward that the old and the new must work together; if a mechanic is thoroughly acquainted with both, he will be a much better employee.

NOTES

An aeroplane was disabled by pigeons recently while making a flight in England. It appears that the machine, an army aeroplane, ran into a large flock of pigeons. The propeller struck a number of the birds, with the result that it was badly shattered. The aviator was forced to volplane to earth.

In 1892, vanadium was listed as the rarest metal and was valued at $4,792 a pound, or twenty times as much as a pound of gold. The discovery of the rich deposits in the Peruvian Andes, 16,200 feet above sea level, in 1905, caused the value of vanadium to drop rapidly; it is now sold at $3.50 a pound. It is being used, however, much more extensively than formerly, and new uses are being constantly found.

A large munitions manufacturer, when he found that over 5,000 cartridge cases had been spoiled, evolved the idea of making an ornamental beverage holder from a shrapnel shell fuse and cartridge case. The cartridge case contains a rack holding four glasses; inside the shell is a container which holds the beverage, and the fuse acts as a cover. The original shrapnel shell, loaded and ready for firing, sold for $15. This beverage holder, not "loaded" nor made to specifications, sells for $10.

The Standard Oil Company turned gas into the lines of its new compressor plant in Taft, Cal., on the famous McNee lease, on section 36, 31-23, and it was given its full initial tryout. The plant is one of the largest in the state used for the compression of gas of both high and low pressure. Combined with the plant which was built some months ago, 20,000,000 cubic feet of gas can be handled daily.

A boiler maker and his helper, as recently reported from Australia, entered the water tank of a locomotive through the manhole and, as the weather was cold, they took in a drum of live coals with them. Some hours later both were found lying dead at the bottom of the tank, killed by carbon monoxide. This was merely an unwitting repetition of the familiar French mode of suicide with a brazier of glowing charcoal.

Mushrooms will be grown in Pennsylvania coal mines by the Colin Mushroom Co., with headquarters at Arnold, Westmoreland County, a town on the bank of the Allegheny near Pittsburgh. There are about 20 old workings of the Valley Camp Coal Co., which have been exhausted of their coal supply and have not been used for many years, and these have been leased by the new company and will be provided with mushroom beds. About 25 men will be employed.

At a colliery in Rutherglen, Scotland, there was, until recently, an old "atmospheric" engine in use. The engine had been at work at the colliery for hoisting coal since it was erected in 1809. During that time, no part had been renewed, with the exception of two spur gears which were broken by accident. The engine was superseded by one of the modern construction a few months ago, and was then the oldest engine in use in Scotland, and the only one of the "atmospheric" type in use in Great Britain.

Lassen Peak, the most active and interesting volcano in the United States, is named for Peter Lassen, a pioneer who guided many an early settler to the sunny lands of the Sacramento. As Lassen never owned the mountain, in later years the possessive form of the name was dropped, and to correct a tendency to wander from well-established usage the United States Geographic Board, in its decision of October 9, 1915, officially recognized the fact that the name of the mountain was *Lassen Peak,* not Mount Lassen.

There are three different kinds of dynamite. The ordinary dynamite, which crystallises, or, as commonly said, freezes between 46 deg. Fah. and 52 deg. Fah.; the "low-freezing" dynamite, or ammonia dynamite, which does not freeze above 35 deg. Fah.; and another dynamite called non-freezing, which freezes at below 10 deg. Fah. Frozen dynamite is less sensitive to shock and consequently becomes less efficient. On the other hand, by vigorous friction, it may explode, and therefore, is dangerous. In cold weather, dynamite must be thawed before using.

Powdered coal in storage will ignite spontaneously more rapidly than before pulverization. When such powdered fuel contains 0.75 per cent. of moisture and 1 per cent. of sulphur, it will invariably fire within six days. If the moisture be increased to over 1 per cent. and the sulphur to 4 or 5 per cent., spontaneous combustion may occur within 24 hr. Probably the temperature at which powdered coal is delivered to the storage bin and the sulphur content of the coal influence the rate of spontaneous combustion more markedly than does the percentage of moisture.

Live fish are reported to have been found in the bottom of a Transvaal gold mine, in a vertical shaft 3,800 ft. deep. They were barbel, from 6 in. to 12 in. long, and up to three-quarters of a pound in weight. They must have been merely spawn when they fell, says a correspondent of the *Fishing Gazette.* In exceptionally dry weather, adds the writer, small bull-frogs have been seen to distend themselves and deliberately jump down the shaft, apparently in search of water. How they ever reached the bottom alive is a mystery.

The brown oak, which is famous in England and sells for exorbitant prices in American furniture factories, is justly famous for its beauty. No wood ranks higher and few cost more. Its rich but subdued color is justly praised by those who appreciate rare colors. But why is it brown? An English scientist has discovered that the tone is due to fungus which has penetrated the tree from bark to heart and filled every fiber. The fungus does not seem to promote decay or in any way lessen the strength or affect the durability of the wood.

The Brasher air breakwater, which is to protect the Standard Oil pier at El Segundo, California, described in *Compressed Air Mag-*

azine, May, 1916, page 7980, has recently been completed at a cost of $10,000 for the 1,700 ft. of pipe and its installation. The pipe is 4 in. with ¼-in. perforations 6 in. apart. An air compressing plant supplies the air to the pipes at the pressure determined by the depth of submergence. This air rising through the water gives it a certain elasticity and is expected to calm the surface sufficiently for safely loading and unloading the tankers.

Through the use of a pulmotor, operated by M. E. Gregson of the distribution department of the New York Edison Co., the life of a four-hour old infant was saved recently, says the Edison Weekly. Shortly after nine o'clock in the morning, Dr. J. Kramer phoned to The New York Edison Co. for assistance, stating that a baby boy's lungs had collapsed. Mr. Gregson received the call at 9.42 and made a grab for the pulmotor and oxygen tanks. By 11.50, after two hours work, the infant became conscious and a moment later began to cry in a decidedly boy-like manner.

The mining stock of the highest share value in the world is that of the Union Sulphur Company, producer of four-fifths of the world's sulphur. There are only 2,000 shares, but they have an appraised value of $12,003 per share or a total at this rate of $24,006,000, but at this, or any other, price it is impossible to buy a share. Several years ago a few shares of the stock brought $19,400 per share. On Jan. 1, 1916, the company had undivided profits of $6,360,688, equal to $3,180 per share on its outstanding stock. At the same time the company carried a stock of 1,127,596 tons of sulphur. Assuming an average of $22 a ton this would be worth $24,907,112; but it is understood that sulphur has since advanced to about $28 a ton, giving this tonnage a total value of $31,572,688. Assuming an average cost of $10 per ton and an average profit of $18, there was a stockholders equity of close to $10,148 per share, or a total, including undivided profits, of over $13,000 per share. Dividends are now being paid at the rate of 2250% annually.

The Panama Canal channel through Culebra Cut, according to the Panama Canal *Record,* is now in better condition than ever before. The cut which has been dredged through the slides has a minimum depth of 33 ft. and the least width of a channel of 30 ft. depth is 180 ft. at the point opposite the rock known as Gibraltar. This rock projects into the channel about 110 ft. and extends along the channel about 200 ft. It has been blasted away until it now rises only about 30 ft. above the water. The dredges "Corozal" and "Paraiso" are at work on the removal of this rock and are dredging behind it to prevent its being pushed forward.

A new process of supplying pure air to submarines has been discovered. The inventor, William G. Bond, of Wilmington, Del., recently demonstrated the use of his apparatus by remaining in a test chamber 3 feet by 4 feet by 6 feet for seven hours with only the air furnished by his device. The air is purified by a chemical reaction between carbon dioxide and certain solutions exposed to the atmosphere of the chamber. The carbon is absorbed and the oxygen liberated. The test room used was entirely surrounded by water. Mr. Bond entered the tank clad in a bathing suit and supplied with reading matter, food, air-testing apparatus and the chemicals. He kept in communication with the observers on the outside by means of a telephone.

A project for the construction of a tunnel under the Bosporus is being discussed at Constantinople. Engineers have worked out detailed plans showing that the project is feasible and financially profitable, while its strategic importance is obvious.

The quantity of artificial gas—oil and water gas and coal gas made at retorts and by-product coke ovens—marketed and sold in 1915, was 266,204,248,000 cubic feet, valued at $173,832,132.

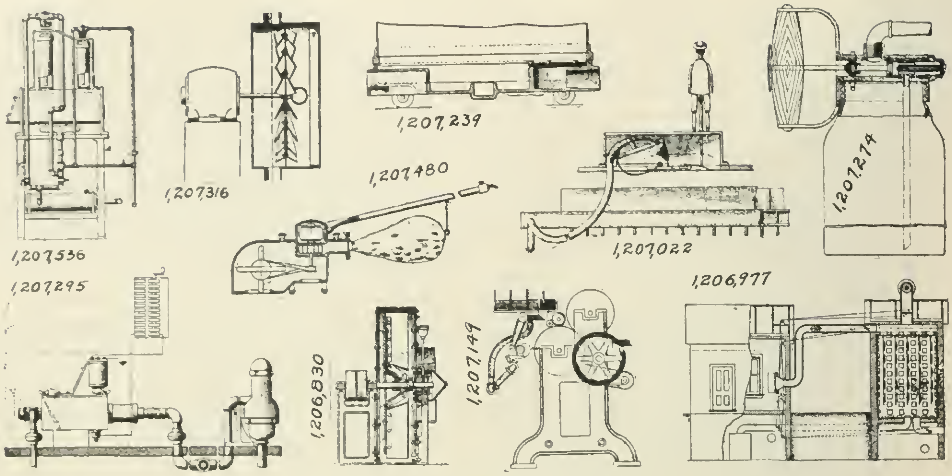
LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

DECEMBER 5

1,206,828. PROCESS OF DRYING THE COMPOSITION HEADS OF MATCHES. WILLIAM A. FAIRBURN, Short Hills, N. J.

1. In the manufacture of matches upon a continuous match machine, a process which consists in applying to the match splints composition heads or bulbs containing an oxidizing agent as an ingredient; and then transporting the splints·



Pneumatic Patents December 5.

thus treated through a series of drying zones, wherein they are subjected first to air currents of successively increasing temperatures and then to air currents of successively decreasing temperatures.

1,206,830. CENTER-SUCTION FAN. Franklin A. Fleck, Middletown, Pa.

1,206,977. PROCESS OF CONTROLLING THE HUMIDITY OF THE ATMOSPHERE. Frank Batter, Linnton, Oreg.

1,207,022. DANCING TOY. Clifford H. Green, Grand Rapids, Mich.

1,207,149. PNEUMATIC PRESS - FEEDING MEANS. James Duvall, Camas, Wash.

1,207,165. AIR-COMPRESSOR. Chester A. Herle, Rochester, N. Y.

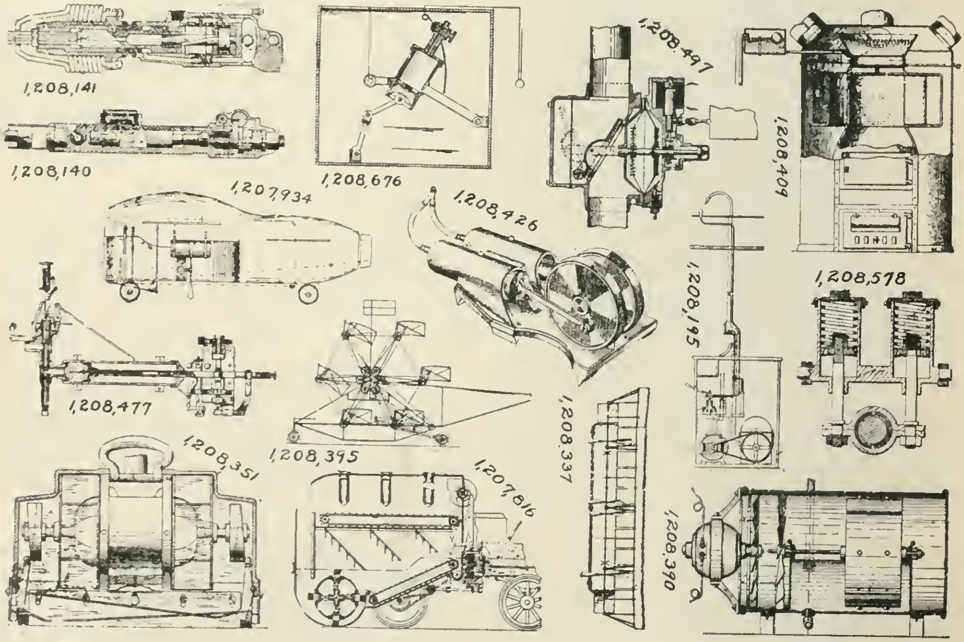
1,207,239. VACUUM - CLEANER MUFFLER. Joseph H. Templin, Philadelphia. Pa.

1,207,274. SPRAYING OR ATOMIZING DEVICE. William C. Carter, St. Louis, Mo.

1,207,295. MEANS FOR CONTROLLING ELECTRICALLY-PROPELLED VEHICLES. Oscar Johnson, Chicago, Ill.

1,207,316. AIR-CIRCULATING APPARATUS. Mosby Montague, Christiansburg, Va.

1,207,480. COMBINED SUCTION - CLEANER, BLOWER, AND POLISHING DEVICE. Benjamin F. Blake, Marion, Ohio.



Pneumatic Patents December 12.

1,207,536. MEANS FOR CONTROLLING TEMPERATURES. Harry E. Gilbert, Conshohocken, Pa.

1,207,568. PNEUMATIC ACTION. Frederick A. Landgren, Sycamore, Ill.

DECEMBER 12

1,207,772. PNEUMATIC CUSHION. Irving A. Lake, New York, N. Y.

1,207,813-4. METHOD FOR PRESERVING TENNIS-BALLS OR OTHER OBJECTS CONTAINING FLUID UNDER PRESSURE. Frank W. Stockton, Chicago, Ill.

1,207,816. STREET - SWEEPER. Carl G. Thompson, Sullivan, Ind.

1,207,893. COMPRESSION REFRIGERATING-MACHINE. Carl C. Gerlach, Cleveland, Ohio.

1,207,934. AIRSHIP. Augustus Peter Koch, New York, N. Y.

1,208,140. FLUID-OPERATED TOOL. Louis W. Greve, Cleveland, Ohio.

1,208,141. FLUID - OPERATED DRILLING-MACHINE. Louis W. Greve, Cleveland, Ohio.

1,208,337. AIRSHIP. Herman Leinweber, Chicago, Ill.; Curt Leinweber and Fred H. Leinweber executors of said Herman Leinweber, deceased.

1,208,351. VACUUM FLOOR-CLEANER. Albert E. Moorhead, San Francisco, Cal.

1,208,389. FIRE - ALARM OR SIGNALING SYSTEM. James M. Seymour, Jr., Newark, N. J.

1,208,390. COOLING AND HUMIDIFYING APPARATUS. James M. Seymour, Jr., Newark, N. J.

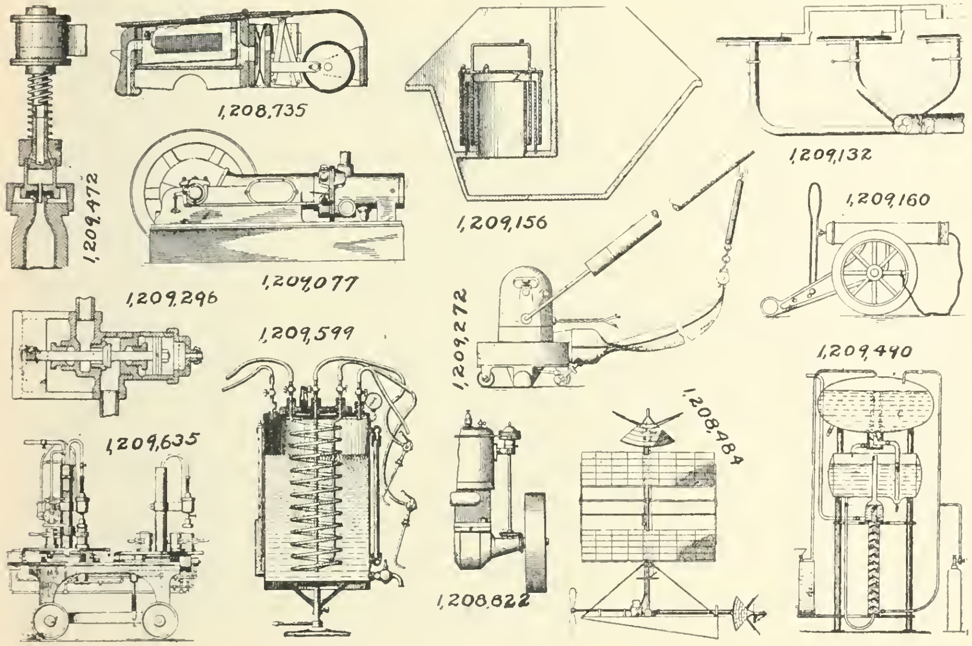
1,208,395. FLYING-MACHINE. Ruter W. Springer, U. S. Army.

1,208,409. HUMIDIFIER. Dewitt Van Evera, Chicago, Ill.

1,208,426. AIR-COMPRESSING PUMP. William Joseph White and William Frank Neal, Birmingham, Ala.

1,208,475. ATOMIZER. Ray Hugh Callan, Trenton, Mo.

1,208,477. PNEUMATIC TYPE-WRITER CARRIAGE. George E. Callaway, De Soto parish, La.



Pneumatic Patents December 19.

1,208,165. VACUUM CLEANING-TOOL. Gordon E. Kent, Rome, N. Y.

1,208,195. PNEUMATIC - DESPATCH - TUBE APPARATUS. Albert W. Pearsall, Lowell, Mass.

1,208,325. DEVICE FOR CONDENSING AND VACUUM-PRODUCING. Emil Josse, Berlin-Lankwitz, and Wilhelm Gensecke, Berlin, Germany.

1. In a condensing plant the combination of a surface condenser, cooling means for said condenser, a water circulating system independent of the cooling means, pressure means included in said system to maintain the circulation thereof, a jet actuated by the pressure means and arranged to withdraw air and condensate simultaneously from said condenser through a single discharge opening and an open tank in said water circulating system whereby air is permitted to pass off and a surface of evaporation is provided.

1,208,497. PNEUMATIC-DESPATCH APPARATUS. James T. Cowley, Minot, Mass.

1,208,578. AIR - CUSHION FOR AUTOMOBILES. Romanus Krause, Belhaven, N. C.

1,208,676. ELECTRIC PNEUMATIC TIME-SWITCH. Orvall Smiley and Earl C. Applegate, Indianapolis, and Guy R. Bennett, Fort Wayne, Ind.

DECEMBER 19

1,208,735. VACUUM-CLEANER. Homer L. Boyle, Lansing, Mich.

1,208,822. LOCKING MEANS FOR INTERNAL-COMBUSTION MOTORS. Casin W. Obert, Brooklyn, N. Y.

1,208,984. FLYING-MACHINE. James Kreiter, Fredericksburg, Ohio.

1,209,077. OPERATING MEANS FOR COMPRESSOR-VALVES. Frank M. Titus and Delmar B. Schwab, Bradford, Pa.

1,209,132. MACHINE FOR SUBJECTING AIR TO VIOLET AND ULTRA-VIOLET RAYS. Noah W. Davis, Des Moines, Iowa.

1,209,156. PNEUMATIC FLUME-GATE. Perry L. Hedrick, El Centro, Cal.

1,209,160. TOY CANNON. David Heyman and Thomas Raymond Arden, Brooklyn, N. Y.

1,209,223-4. DIVING-DRESS. Hermann Stelzner, Lubeck, Germany.

1,209,272. SUCTION-CLEANER. Frederick A. English, Chicago, Ill.

1,209,296. AUTOMATIC TRAIN - STOPPING DEVICE. William S. Holdship and Frederick L. Jones, Montreal, Quebec, Canada.

1,209,472. BLOW - HEAD FOR BOTTLE-BLOWING MACHINES. John J. Meyer, Jr., Glenshaw, Pa.

1,209,490. APPARATUS FOR IMPREGNATING LIQUIDS WITH CARBONIC ACID OR OTHER GASES. Anders Andersen Pindstofte, Copenhagen, Denmark.

1,209,930. AIR OR GAS COMPRESSOR. Tyrus Douglas Berkeley, Ruabon, Wales.

1,209,944. PNEUMATIC PUMP. Charles A. De Rigne, Los Angeles, Cal.

1,209,954. MACHINE FOR EXHAUSTING AIR FROM PRESERVING VESSELS. William B. Fenn, Columbus, Ohio.

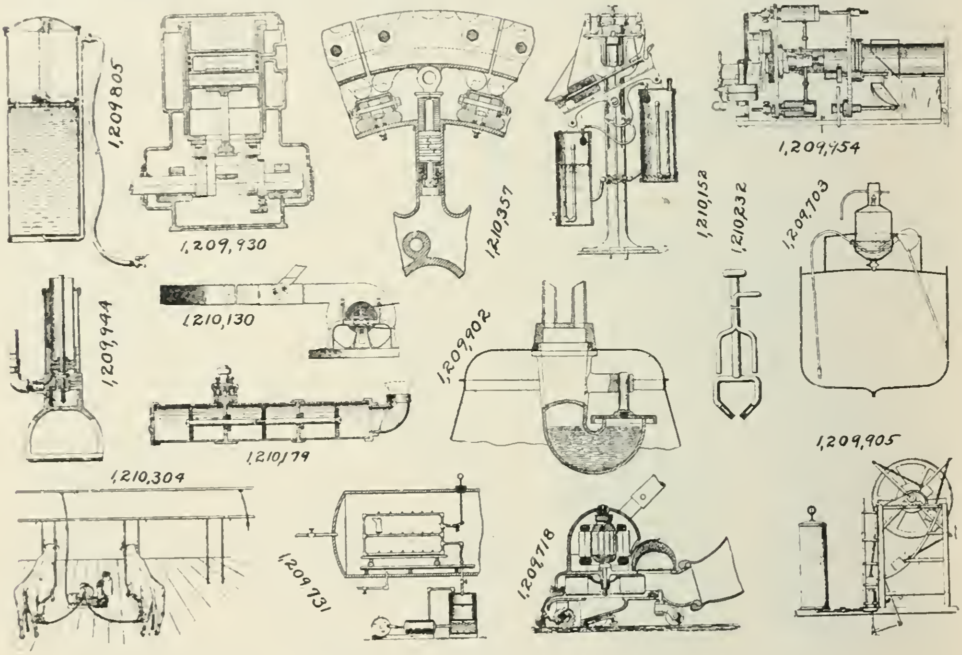
1,209,965. AUTOMATIC AIR - LINE COUPLING. Flavious J. Hollcroft, Jenks, Okla.

1,210,030. BLOWER SYSTEM. Karl Baumann, Chorlton cum Hardy, England.

1. In combination, a plurality of prime movers operating in parallel and means for insuring the equality of the fractional outputs of the several prime movers, said means comprising a plurality of regulators and an equalizing pipe connecting the inlets of said prime movers.

1,210,130. PNEUMATIC CONVEYER. James Alvin Worsham, Maroa, Ill.

1,210,152. PUMP. George Dorffel, Oakland Cal.



Pneumatic Patents December 26.

1,209,599. HOT WATER AND AIR TANK FOR DENTISTS' USE. Harry W. Le Fevre, Denver, Colo.

1,209,635. GLASS-BLOWING MACHINE. Lorenzo Wolford, Alexandria, Va.

DECEMBER 26

1,209,703. ASH - EJECTING MECHANISM. Wilhelm Hartmann, Offenbach-on-the-Main, Germany.

1,209,718-22. VACUUM CLEANING - MACHINE. James B. Kirby, Cleveland, Ohio.

1,209,726. RECOIL-PAD. Paul J. Krueger, Blue Island, Ill.

1,209,731. EXHAUSTING APPARATUS FOR VULCANIZING. Clifford Lee, Naugatuck, Conn.

1,209,805. GREASE-GUN. Hans M. Boe, Minneapolis, Minn.

1,209,851. LUBRICATING SYSTEM. Fritz Koch, St. Paul, Minn.

1,209,902. MILKING MACHINERY. Hector Stewart, Galt, Ontario, Canada.

1,209,905. AIR-COMPRESSOR. Warrington W. Swetland, Los Angeles, Cal.

1,210,179. GREASE-GUN. William H. Lewis, Los Angeles, Cal.

2. A grease gun having a lubricant moving piston, means for applying fluid pressure to the device for moving the piston in one direction for drawing a lubricant into the gun and in the other direction for forcing said lubricant out of the gun.

1,210,232. SPRAY-PRODUCER OR ATOMIZER FOR LIQUIDS. David Hibbert Thomas, Morriston, Wales, Arthur Douglas Berk, London, England, and Frederick John Morgan, Swansea, Wales.

1,210,239. PNEUMATIC PIANO - PLAYER. Eugene C. Wamelink, Cleveland, Ohio.

1,210,246. AUTOMATIC TRAIN - STOP Charles W. Wilson, Berea, Ohio.

1,210,299. PNEUMATIC OR STEAM DRILL. Richard Clayton Fraser, Central City, Colo.

1,210,304. MILKING-MACHINE. James N. Gilman, Berkeley, Cal.

1,210,357. PNEUMATIC-WHEEL. Francesco Persone, Nardo, Italy.

1,210,387. AIR-PUMP. Charles Carey Manker, Ogden, Utah.

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EVERYTHING PNEUMATIC

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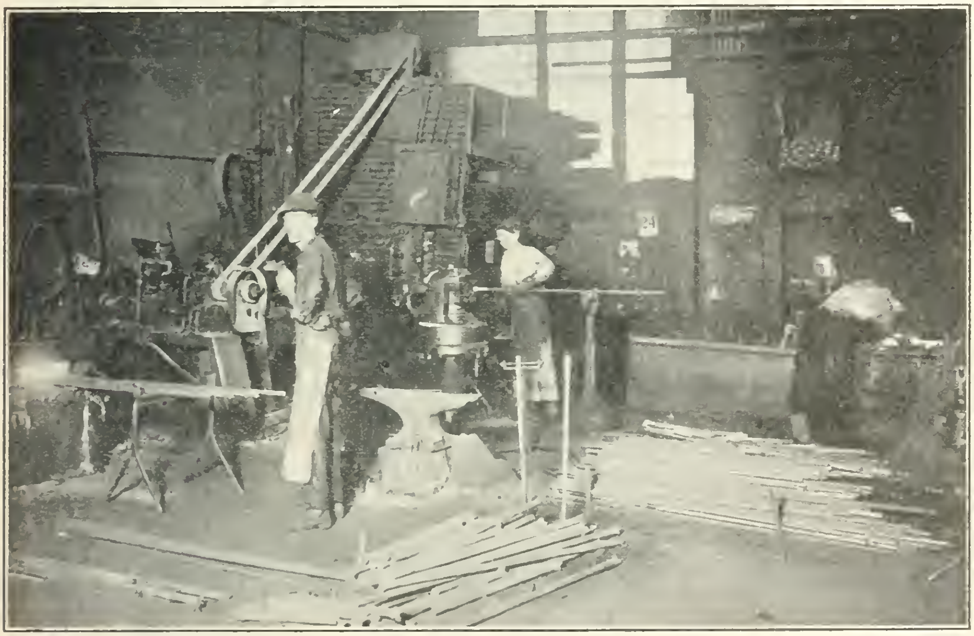

FIG. I. DRILL SHARPENING SHOP AT UNITED VERDE MINE.

DRILL SHARPENING SYSTEM AT UNITED VERDE MINE

BY FRANK RICHARDS*

The ground in the United Verde mine is hard, and as a result the steel is quite dull when it reaches the sharpening plant. This is especially true of the steel used in conjunction with the Leyner drills. The sharpeners are in continuous operation during the entire 8-hr. period. A highly efficient system of collecting, sorting and routing, sharpening and distributing has been developed at this mine.

Dull steels are collected on the various levels underground, brought to the surface and sorted by nippers onto steel cars. These cars consist of trucks on which are mounted four-section bodies, revolving on ball bearings (Fig. 1). By sorting at this point, the blacksmith is saved several miles of walking each day.

The sharpening plant is located aboveground and has three units, each consisting of an oil furnace. Davies air-operated punching ma-

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*Prize article in Engineering News.

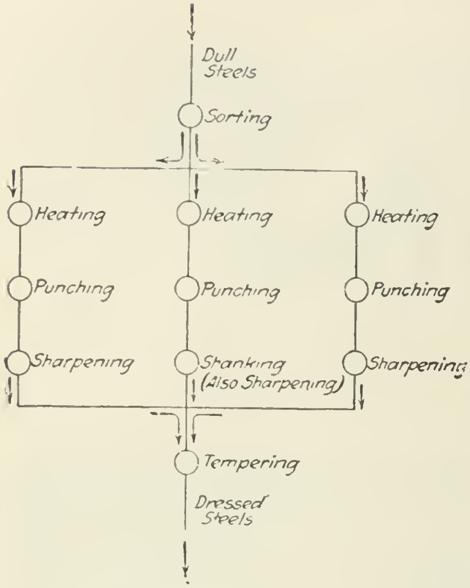


FIG. 2. ROUTE OF STEELS.

chine, Leyner drill sharpener and Davies blow gun.

The steel travels from the dull-steel car in approximately a straight line through each unit to a car for the sharpened steel (Fig. 3). The sequence of operations is as follows: The helper unloads the dull-steel car and places the steel in the furnace; when it comes to the proper heat, he removes it with his right hand, places it in the punching machine, while at the same time his left hand operates a clamping lever, then moves a few inches to the level that controls the punch—the entire operation is completed in 2 to 3 sec. The hole in the steel is opened for 3 to 4 in. The helper passes the steel to the blacksmith, who receives it in his left hand, places it in the sharpener, bringing the machine into operation with his right hand. After the bit is formed, the steel is reversed and the shank end is placed against the blower; this movement is really a step in transferring from the sharpener to the car. It is desirable to stand the steel with the bit up.

This method is identical for each sharpening unit, the sharp-steel cars from all traveling to one tempering forge. The steels are then brought to a tempering heat and delivered to the slack tub. Plunge tempering is employed, the bits in water and the shanks in oil.

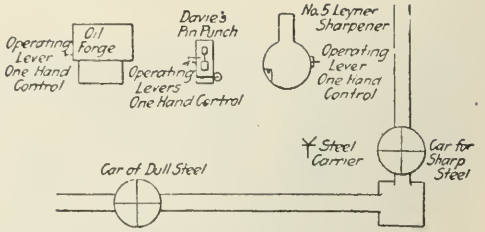

Oil Forge
Operating Lever One Hand Control
Davie's Pin Punch
Operating Levers One Hand Control
No. 5 Leyner Sharpener
Operating Lever One Hand Control
Steel Carrier
Car for Sharp Steel
Car of Dull Steel

FIG. 4. LAYOUT OF A SHARPENING UNIT.

Between the sharpener and the temperer the steel cools to normal temperature and is ready for reheating. The utility man takes care of grinding and dressing the shanks, the No. 3 sharpener being the only one devoted to shanking. Figs. 2 and 4 show the layout of a sharpening unit. The forge is long and low, heating from 15 to 25 steels at one time. The helper starts the steel in the left-hand side of the forge, gradually working it to the right, each steel thus receiving the proper heat and also bringing it into easy removing position.

The punching machine (Fig. 5) consists of an air plunger governed by an oil cylinder. The piston rod carries a chuck for holding the punches. A self-centering clamp operated by an air cylinder insures alignment of steel and punch. This punch has increased the sharpening capacity 50%.

Each steel is tested by a blow gun. The blacksmith, while turning the steel up to place it on the car, pushes the shank against the automatic blow gun. This could be done without reversing the steel, but sparks were sometimes blown upon the operator; and as "Safety First" is one of the mottoes of this shop, the blacksmiths are instructed to test the steel from the shank end. Steel is punched, sharpened and blown out in one heat.

Supervision of drill shanks has resulted in

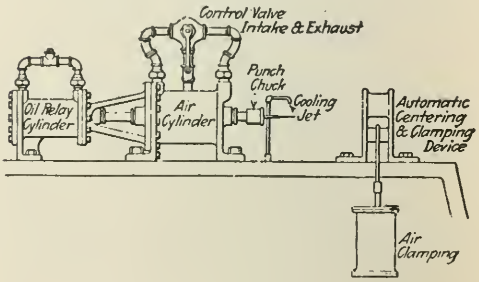

Control Valve Intake & Exhaust
Punch Chuck
Cooling Jet
Oil Relay Cylinder
Air Cylinder
Automatic Centering & Clamping Device
Air Clamping

FIG. 5. PUNCH FOR HOLLOW STEELS.

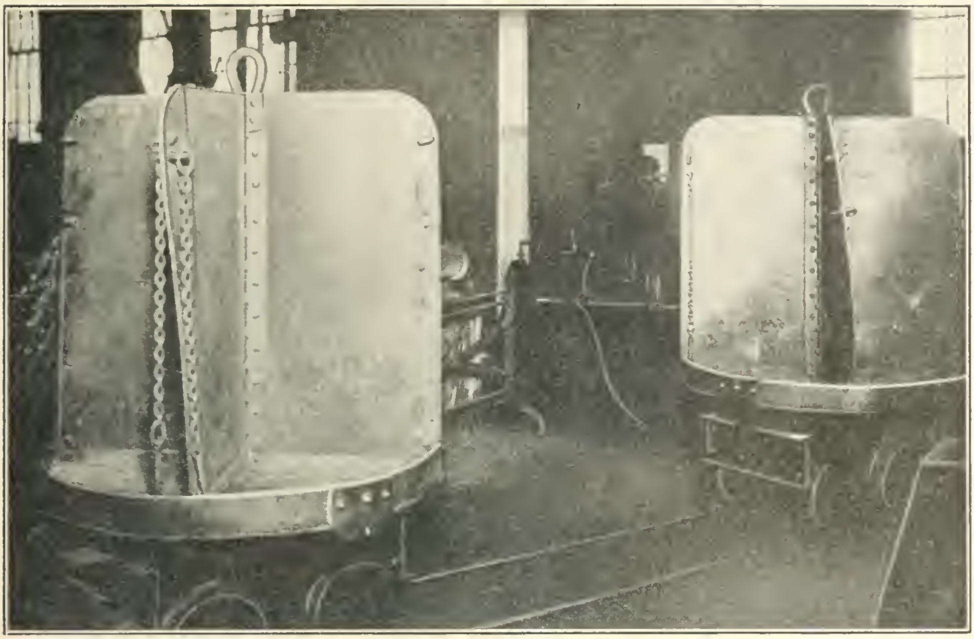


FIG. 3. CARS FOR STEELS, UNITED VERDE MINE.

reducing piston and drill-steel breakage. Out of about 5,000 pieces used, only two to three are broken per shift.

This paper embodies data furnished by Tom Davies, foreman blacksmith, United Verde Co.

Average number of steels sharpened per day	1,800
Type of bits	Crossbits
Length of steels	2 to 10 ft.
Shanks	60% Leyner-Ingersoll drill shanks with lugs, 20% "Jackhamer" shanks with collar, 20% Stopehamer shanks without collar
Grade of steel	0.75 to 0.95% carbon
Sharpening-plant equipment	Two No. 5 Leyner sharpeners and one No. 3 Leyner sharpener, each equipped with Davies hole-blowing device; three Davies punching machines; three oil furnaces and one tempering furnace
Shop blacksmith force	Three operators sharpening, three helpers heating and punching, one blacksmith tempering, and one utility man
Working shift	One 8-hr. shift per day

RUBBER SPONGE

Rubber sponges have been in use for quite a number of years, but until recently no one has attempted to utilize their rather peculiar properties in any other way than as a substitute for the natural sponge. Among the many methods of preparation, the time-honored practice has been to mix with the batch some material such as ammonium carbonate, which at the temperature of vulcanization gives off a considerable volume of gas, and thus causes porosity.

Because of its cellular structure, rubber sponge has several very peculiar properties; for example, it has the lowest apparent specific gravity of all solid bodies, its value being about 0.05. In spite of its cellular structure it is water-tight and very nearly gas-tight. While it is honeycombed with minute cells, each cell is an individual unit and the rate of diffusion of gases through it is comparatively low. Perhaps one of the most important uses to which it has been applied is in the preparation of life-preservers. It will not water-log, is light, conforms easily to the lines of the body, and is not ruined by a pin-prick. A life-raft made with rubber sponge is as nearly proof against careless handling as one can be. All sorts of floating devices, such as buoys, markers, etc., may be improved by its use. A promising application is as a tire filler for automobiles. The most satisfactory tire filler available to date is air. It is now proposed to use rubber sponge molded to fit the inside of the tire casing, and in this manner produce a puncture-proof tire. The car still rides on air, but the air is confined in innumerable little sacs.

Hard rubber sponge is also available. It is prepared from soft rubber sponge by further vulcanization, and has many applications as heat insulating material, and, where lightness is desirable, to many minor structural parts. It has in fact considerable strength, and has been proposed as a material for the framework of aeroplanes. It has also been recommended as a material for constructing automobile bodies.—*Metallurgical and Chemical Engineering.*

COMPRESSED AIR FOR RAILROAD TRACK WORK

Mr. D. P. Falconer, Engineer of Maintenance of May New York State Railways, Rochester, N. Y., has the following to say in a recent issue of Electric Railway Journal:

It is a generally admitted fact that human horsepower is the most expensive kind of power which can be purchased, and it is for this reason that any equipment or machine which will transform electric or other energy into useful work in track construction or maintenance is economical. It is with this idea in mind that this company has endeavored to equip its track gangs with such labor-saving devices as are obtainable and suitable for its use.

One of these tools is the pneumatic tie-tamping outfit which we have had in use for the past two years. We have operated this machine with a gang of five men, one operator, two ballast distributors and two tampers. The ballast distributors and tampers alternate, and in this way avoid any excessive jar or possible fatigue due to the continued use of the tamping tools. The operator is the only man in the gang who is paid more than the regular laborers' rate and we have used common labor entirely for tamping track.

We find we can tamp from seventy to ninety ties per day which, assuming twenty days to the month and six months to a year as a working season, gives us about 4 1-2 miles of track tamped. This, of course, means new track or track which has been entirely reconstructed.

We have not obtained this record, however, with the use of our tamping outfit because we have used this outfit also for installing our riveted joints. A number of other uses for compressed air have been noted in the columns of this paper and undoubtedly this method of transforming energy will find a wide variety of uses in track construction and maintenance.

THE AIR BRUSH FOR METAL PRESS LUBRICATION

The lubrication of the surfaces of sheet metal in punching and drawing presses is more or less imperative and various arrangements are employed for the purpose, the swab or the dope kettle being the most common. In a certain shop where these devices were so evidently wasteful and otherwise most unsatisfactory a hint was finally taken from the paint shop of the same establishment. An air line was run through the shop to the various stands where the material was placed for the press feeders, and a short section of armored air hose attached to each line.

Air brushes were procured, one large one being bought first as a sample. This was found to give accurate placing of lubricant on any shape of blank sheet, and at the same time to keep the wastage down to a minimum, as the stream could be localized to within a close margin of the space actually affected by the pressing operation. The first brush was found too heavy for service if used constantly and smaller sets were obtained for regular use. These served the purpose admirably, and enabled the use of a better grade of lubricant for the same expenditure as was formerly used in covering wastage. The better grade meant longer die service, and consequent lessened die cost per hundred.

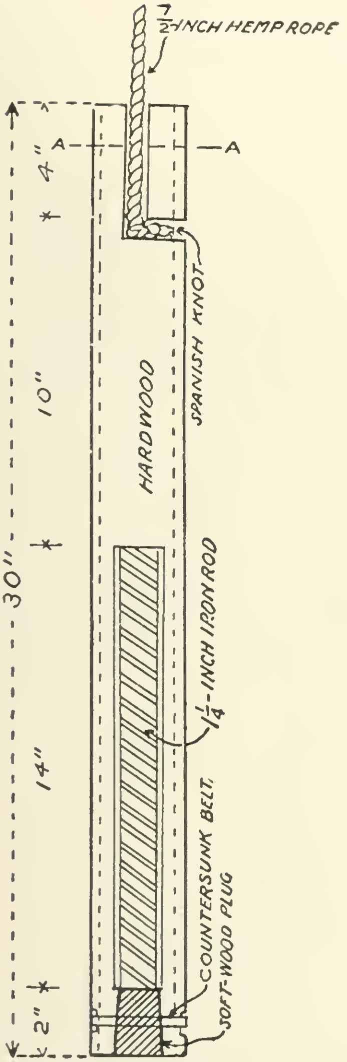


FIG. I. SPRINGING GAGE.

THE "SPRINGING" OF BLAST HOLES IN ROCK

Bulletin 107, one of the latest of the valuable issues of the Bureau of Mines, is entitled "Prospecting and Mining of Copper Ore at Santa Rita, New Mexico," by Donald F. MacDonald and Charles Enzian. It comprises 122 pages of text with many full page half-tones not numbered, and many cuts and tables. It not only describes the actual mining operations in full detail but also deals with the supervising, directing and recording of operations. We reproduce here without further preface one detail of the work, necessarily more or less condensed, which should be of interest to many of our readers.

SPRINGING OR CHAMBERING HOLES

Before the drill holes are loaded and blasted, one or more small charges are exploded in the bottom of each, to make an enlarged chamber for the final charge. This is known as "springing" or chambering the holes. The aim is to make so large a chamber at the bottom of the hole that the charge may be concentrated into so compact a mass that none of it will fail to detonate, and that the explosive energy may be concentrated where it will give the maximum effect. The springing eliminates any water that may be in the hole, but it generally increases the liability of an inflow of water by shattering and fissuring the surrounding rock. If granulated powder can be forced into these fissured places the effectiveness of the blast is greatly increased.

Where the rock to be broken is relatively soft and weak, and the drill holes not more than, say, 30 feet deep and not over a third of that distance back from the face of a steam-shovel cut, one "springing" is usually all that is necessary. Where the rock is hard and tough, or where the holes are very deep, as many as four successive springing charges may be required before a chamber large enough for the final blasting charge is made. After each successive "springing" the hole

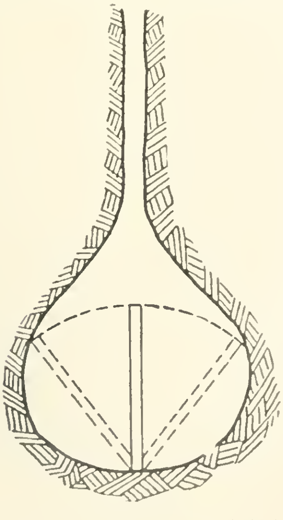


FIG. 2. USE OF SPRINGING GAGE.

must be cooled off, generally with water, before another charge is introduced.

PLUMMET FOR SOUNDING.

Both before and after springing the drill holes are sounded by a specially constructed plummet, a billet of hard wood about 30 inches long and having a metal weight in the lower end. This sounding apparatus, known as a "springing gage," Fig. 1, is attached to a rope and lowered into the hole. By tilting it from side to side while the lower end rests on the bottom, Fig. 2, the experienced chargeman can estimate the size of the hole. With this gage he also measures the depth of water in the hole. A small hand mirror is at times very useful for reflecting light into the hole, thus enabling inspection of the upper 10 to 30 feet.

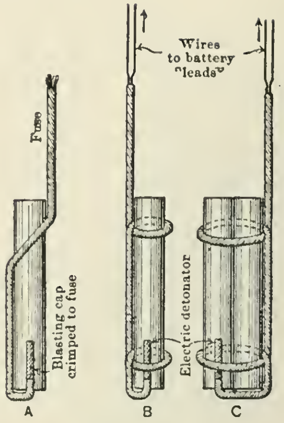


FIG. 3. FUSES.

The procedure in springing holes is somewhat as follows: The chargeman lowers the springing gage into the hole and notes its size and depth, the depth of water, etc. He then drops in the springing charge and again lowers the gage to determine whether the charge has reached the bottom. A fuse, passed diagonally through a stick of dynamite about 2 inches from one end, extends along the side of the stick to the other end, into which the end containing the detonator is inserted about 2½ inches, Fig. 3, A. This stick of dynamite, with cap and fuse attached, is called a primer. The fuse is then lighted and the primer is dropped or lowered into the charged hole, followed by a hurried lowering of the gage to show whether the primer has reached the bot-

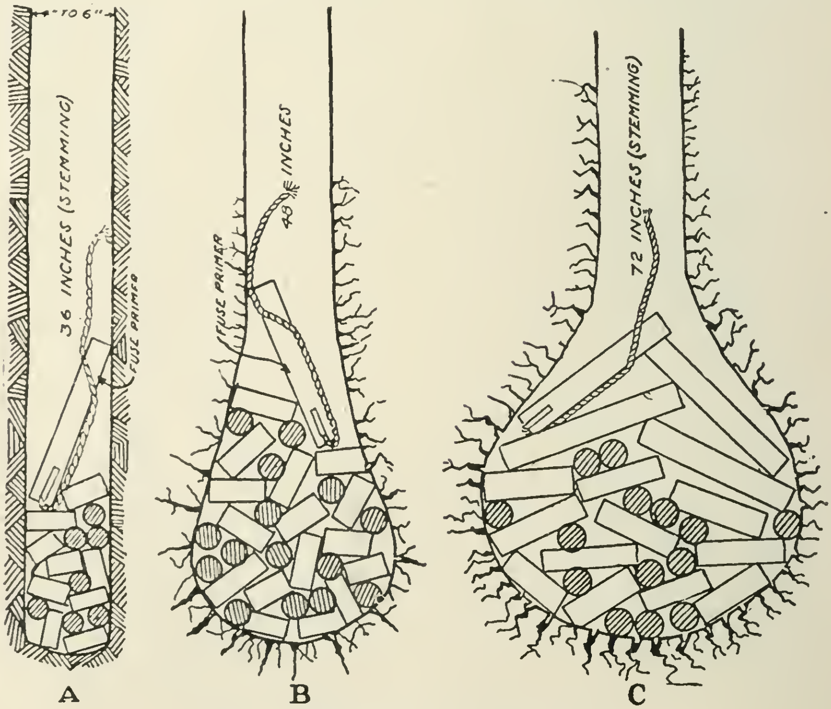


FIG. 4. SUCCESSIVE CHARGES FOR SPRINGING.

tom. After this 2 to 4 gallons of water is poured in as "stemming," the gage is quickly withdrawn, and the chargeman retreats to a safe distance. After the detonation the gage is again lowered and the size of the chamber estimated. If necessary other springing charges are used, each about twice as large as the preceding one, until the hole is sufficiently widened or chambered out at the base to receive a proper blasting charge, Fig. 4. For the third springing, where the holes are over 30 feet deep, and often for the second springing if much water is present, electric detonation is used, Fig. 3, B and C. Where there are several holes to be fired simultaneously electricity is employed instead of fuse. The lead wires or detonating wires are connected in series and the detonators tested with a galvanometer. The lead wires are then connected with a battery and the charges are fired.

CHARGING AND FIRING

The blasting squad usually consists of a charge man or powder man and four helpers.

The charge man places all explosives in the drill holes, except in the "springing" of short holes, when the work may be done by the assistant charge man. The helpers carry the explosives and accessories to the charge man while he is gaging the hole and charging it.

The amount of the charge for each hole varies according to the toughness of the rock, the position of the hole with relation to the face and to other holes, and its depth and extent of chambering. The drill holes to be blasted are "bank holes"—those drilled vertically on each bench and situated back approximately one-third of their depth from the edge of the bench—and "toe holes"—those driven into the face of the bench, say, 4 to 6 feet above the shovel level at the foot of the bench. The toe holes are driven with a downward slope of 20° to 30° below the horizontal.

When the holes are sufficiently chambered or sprung and are ready for loading, an electric-detonator primer, prepared as shown in figure 8, C, is carefully lowered to the bottom of the hole. The first part of the charge, varying from 100 to 300 pounds, is dropped in after it. Another primer is then placed in the hole and the remainder of the charge, 75 to 250 pounds, is added, Fig. 5. During the process of loading, the charge man frequently drops in his gage, to determine how rapidly the hole is filling and to guard against the clogging of the powder. Often granulated Trojan powder is poured in to fill the interstices between the sticks of dynamite and the fissured places in the rock, Fig. 5. Thus air spaces are minimized and the efficiency of the blast greatly increased. When the charge is all placed, screened clayey sand and loam are carefully shoveled into the hole and packed down for stemming.

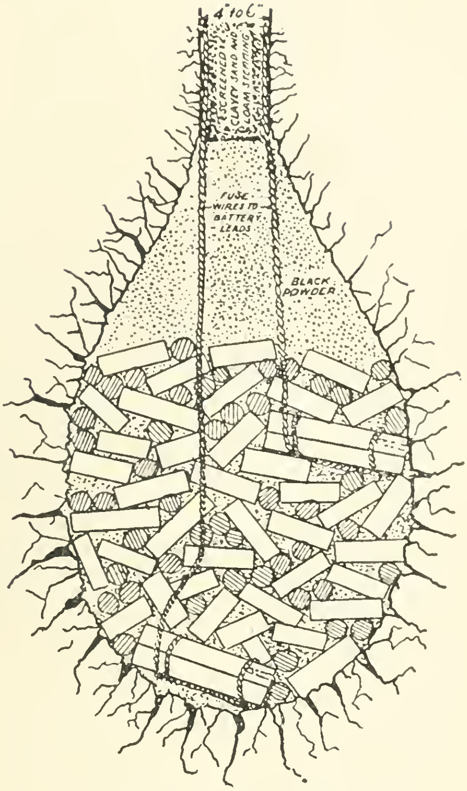
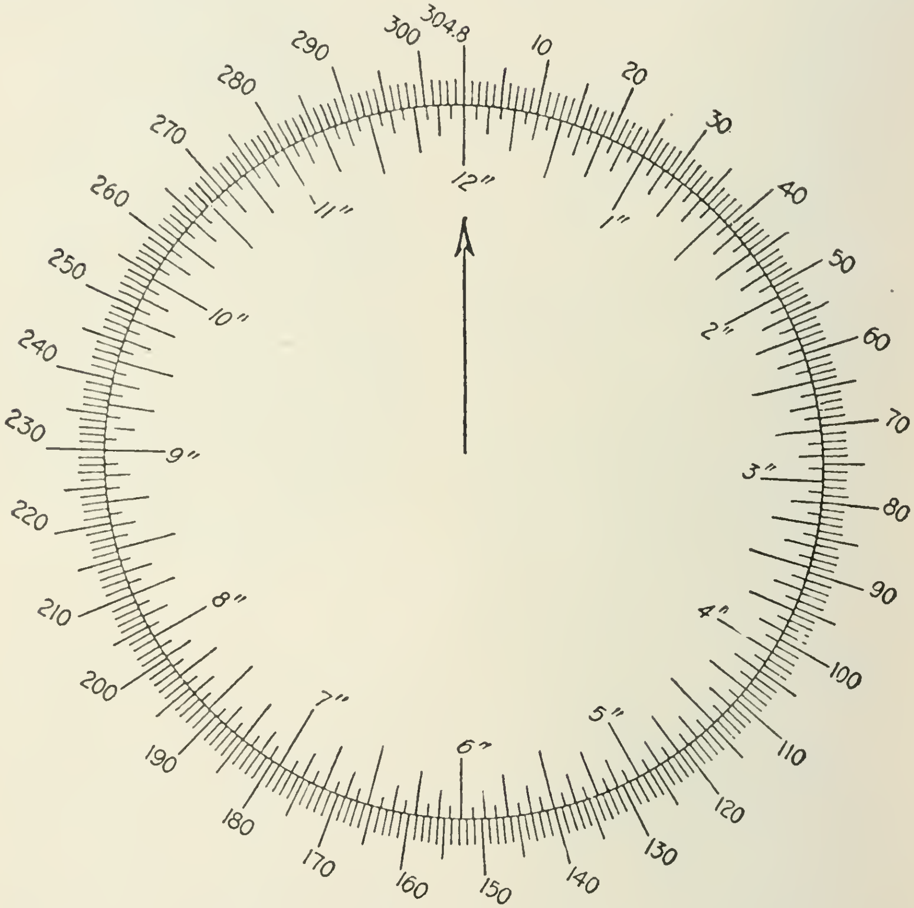

4" to 6"
SCREENED CLAYEY SAND AND LOAM STEMMING
FUSE WIRES TO BATTERY LEADS
BLACK POWDER

FIG. 5. THE FINAL CHARGE.

All blasting is done at such time as will least interfere with the operation of steam shovels, trains, drilling machines and general work. Wherever practicable the blasting is done at the end or before the beginning of the shift or during the noon period. A great deal of blasting is also done by the night squad.

The rules of the company prohibit more than one independent charge in any hole; that is, the explosives must be so placed that no stemming separates any part or parts of the total charge in any hole. Double or triple charges, separated by stemming, are not allowed to be put into one hole, owing to the danger from incomplete detonation. A part of the charge under such conditions might not explode, thus rendering subsequent steam-shovel operations dangerous, for unexploded dynamite is sometimes set off when dug into by steam shovels.



A METRIC CONVERSION CHART

We reproduce on this page a metric conversion chart which has appeared in two or three of the publications of the Hill Publishing Company, and we have taken the trouble to enlarge it to actual dimensions measured circumferentially. It of course requires no explanation, the inches and fractions being on the inside and the equivalent millimeters on the outside. It is ingenuously suggested that "similar charts could be made for feet, yards, miles, units of area, ounces, pounds, pints, quarts, gallons, etc. A collection of such conversion charts could be carried in a little leather case, to be slung over the shoulder, not much bigger than an 8x10 camera and would not weigh much over 10 lb. and would render the compulsory use of the metric system just as simple as anything."

Serious consideration in Great Britain is being given to a project to build a ship canal across the middle of Scotland, linking up the Firth of Forth with the Firth of Clyde. This would give a short route from the North Sea to the Atlantic Ocean.

SELECTION OF EXPLOSIVES FOR DIFFERENT QUARRY CONDITIONS

The following list of explosives and of the various quarry conditions for which each is most suitable is embodied in an article in the Du Pont Magazine by S. R. Russell in which he describes various quarry methods:

Limestone Used for Flux or Lime Manufacture

Bench System: Small Tripod Holes	30% to 40% Red Cross Extra Dynamite or Arctic No. 6.
Snake Holes	Spring with 40% R. C. N. G. and load with 40% R. C. Ext. or Arctic No. 6.
Well Drilling:	
Heavy Ledges	50% to 60% straight in the bottom and 30% to 40% R. C. straight or Arctic Powders on top.
Thinly Laminated	40% to 50% N. G. in the bottom and 40% R. C. Extra on top, or Arctic Powders.
Cliff Quarries	Spring with 40% R. C. Straight, load with Du Pont FFF Black Powder.
Hard Limestone, Using the Tunnel Method	Du Pont RRP and 40% R. C., using about 80% of RRP and 20% Dynamite.

Harder Limestone for Commercial Purposes

Bench System	40% R. C. Ext. or N. G., according to the degree of hardness.
Snake Hole Method	Spring with 60%, load with 40% R. C. N. G. or 40% Gelatin.
Well Drilling	60% Dynamite in the bottom, 40% R. C. on top or Arctic Powders.
Cliff Quarries	Spring with 40% R. C. Straight and load R. R. P.
Tunnel Method	Load with Du Pont R. R. P. and 60% N. G. 80% of total load R. R. P. and 20% Dynamite.

Granites and Traps

Bench Holes	40% Straight.
Well Drilling	60% Straight or Gelatin.
Snake Holing	60% Straight or 60% Gelatin.

Sand Quarries

Where sand is used for manufacture of glass, for molding or other purposes.

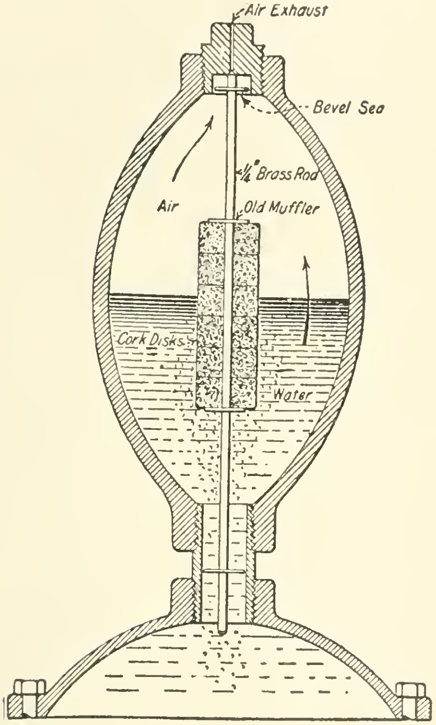
Bench System	30% R. C. Extra or Arctic No. 6.
Well Drilling	30% R. C. Extra in the bottom and Du Font R. R. P. on top or Arctic No. 6 all through.

Slag Quarries

Red Cross 25% Extra or Monobel No. 6.

Shale Quarries

Red Cross 30% Ext. or Arctic No. 6 or a combination in well drilling of the above and Du Pont R. R. P.



AIR RELIEF ON PUMP DISCHARGE

We were constantly annoyed by air in the suction pipe leading to our water-supply pump at the United States dry dock here (Keokuk, Iowa). The 4-in. pipe, about 150 ft. long with an 8-ft. lift, is designed for fire service as well as for the ordinary supply about the grounds. The water passes so slowly through the pipe under ordinary circumstances that air collects in the pump and the discharge loses its pressure and allows the pump to run away. It occurred to me to get rid of the air in the manner shown.

A 2-in. nipple was screwed into the cap on the pump chamber and an old muffler of cast iron was connected, as shown, with a float, etc., to act as an air reservoir and relief so that when the air collects it is automatically discharged and the pump keeps on working, discharging air from this snifter valve and water to the service main. This has given entire satisfaction and works perfectly without any attention. We do not think there is any leak in the suction pipe, but simply a separating out of air from the water due to the vacuum. In cold weather apparently there is more air in the water than in hot.

A glass of water drawn from the city mains in cold weather looks milky, with air bubbles, and it is this dissolved air that our snifter takes care of.—*M. Meigs, in Power.*

BRITISH ENGINEERS IN THE WAR

BY ONE AT THE FRONT

The ramifications of the work of the Royal Engineers are so numerous that it is difficult to say where their work begins and ends, but it may safely be said that it begins with the experts in the munition factories in England, and ends with the tunneling companies of the Royal Engineers in front of our front line in No Man's Land and on all the lines of communication, both in France and other theatres of this war, making sidings, constructing roads, bridging rivers, and making huts for the troops. Nearer the front line their work is still more in evidence when the upkeep of roads, the construction of light railways require constant attention. In this war the construction of dug-outs underground for the safe housing of troops, secure from the effect of shell fire, is of great importance. These dug-outs are constructed in the front line and right back to our supports. Battalion and Brigade headquarters are now all built underground, and well protected from high explosive shells. Most of this work falls to the Royal Engineers assisted by the Infantry and Cavalry as fatigue parties. They are also responsible for the wire entanglements in front of our lines, though the work is now largely given over to the Infantry who hold the lines, but the Royal Engineers have to supply the wire, stakes and tools for this work. The laying out of trenches and traverses also comes within their sphere. The riveting of trenches, the supply of duck-boards for the bottom of trenches, and the making of "sump holes" for drainage, also the supply of all timber, planks and engineering stores of all kinds are in their hands. They have a large army of carpenters, blacksmiths, timber men and experts at almost every trade at the front.

TUNNELING

Several branches of the Royal Engineers have been formed, among others the tunneling and signalling companies. The tunneling companies were formed shortly after the war settled down into a trench siege system. They are made up of miners from all over Great Britain and her Colonies; their work is to keep our front line safe from attacks of enemy sappers, and to carry underground warfare into and under the enemy's first line. It may safely be said that the British miner has upheld the honour of the Royal Engineers, an honour which is always very jealously guarded. Then there is the signalling section, responsible for the telephone connection the Battalion Brigade and Divisional and Army Headquarters, and for the laying of advance lines during an advance; also for the supply of wire and instruments to the Royal Artillery, to connect their batteries with their observers in the front line.

In Gallipoli, the Royal Engineers were responsible for the building and maintenance of the pontoons and jetties for the landing of troops and stores. In the event of a retreat or an excavation, it is they who are responsible for the destruction of stores, ammunition and guns, and for the blowing up of railway lines, roads and bridges; just as when an advance is made, they are responsible for the construction of roads, bridges and railways. In fact they are responsible for the whole of our lines of communication from England to our front line, both in France and other areas of war, except for the strip of blue sea so ably guarded and held by our Navy, which has never allowed this communication—and a very large strip it is—to be interrupted or cut by the enemy.

AVIATION

As to the work of the aircraft in the field it would fill a volume, but attention may be drawn to the immense stride made in our air service and air defences, and the extraordinary progress in efficiency, and the good work our airmen have done both actively and passively in repelling Zeppelin raids. All this work has been done, and these great results achieved, since August, 1914. Truly a marvellous transformation in a little over two years! It is true of our Flying Corps as of other branches of our army, that its work is mainly to assist the "man with the bayonet." By its continuous observation it is able to inform our Staff when and where a large concentration of the enemy is being made, and when and where an attack is likely to take place. It is able to so direct our artillery fire as to destroy the enemy's emplacements, knock out his guns and destroy his trenches, and play upon his lines of communication. By dropping bombs on railway centres and ammunition depots, the airman disorganizes the enemy's supplies. By hovering continually over our advancing troops he enables our artillery to raise or lower their curtain of fire or barrage, and with the aid of science, mainly through his aerial photographs, he enables our troops to know the exact position of the enemy's trenches and strong points.

DUST COLLECTING BY WHOLESALE

BY JOHN L. ALDEN

Aside from the production machinery of the new plants of the Remington Arms Co. of Delaware, Eddystone, Penn., much of the auxiliary equipment is unusual and interesting. This is particularly true of the dust-collecting systems. Not only are these larger than the ordinary commercial installations, but their very size has necessitated some radical departures from what has hitherto been standard practice. One of these installations embodying some of the latest engineering developments has been designed and installed by the Oneida Steel Pulley Co., Oneida, N. Y.

The polishing room of this plant is 216x80 ft., lighted from above by skylights in the monitor, about 70 ft. above the floor. The general arrangement of the 628 polishing wheels is shown in Fig. 1. Across a wide trucking aisle is the browning department, which has two groups of 25 wheels and brushes each. The total number of wheels connected to exhaust systems is 678. Wheels 18x5 in. are mounted on the jacks in the middle of the room. Along the line of columns on each side of the room are two rows of small bench polishers fitted with 6x2-in. wheels or smaller. The wheels in the browning room are 12x4 in. and 12x5 in.

The two styles of dust hoods for the large wheels are illustrated in Fig. 2. Of these, 96 wheels operate as "overshot," while the remainder, 192, run in the opposite direction. Corresponding wheels on opposite pairs of jacks standing back to back are connected to the same branch pipe. The connection to each hood is rectangular and is equivalent in capacity to a 3½-in. round pipe. The bench wheels and those in the browning room are connected in pairs through rectangular breechings. The two wheels on the same spindle use the same branch. In the browning room each opening is equivalent to a 3½-in. pipe, while those of the small bench wheels are equal to 3-in. round branches.

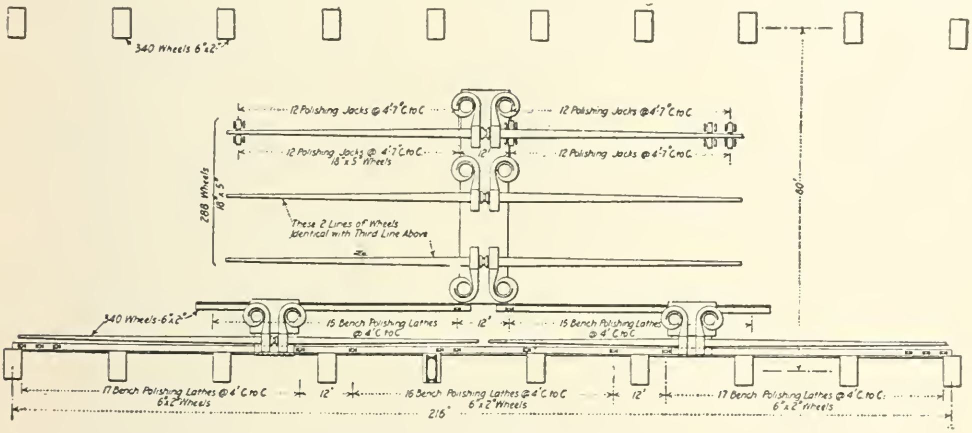

340 Wheels 6"x2"
12 Polishing Jacks @ 4'7" C to C
12 Polishing Jacks @ 4'7" C to C
12 Polishing Jacks @ 4'7" C to C
18"x5" Wheels
12'
12 Polishing Jacks @ 4'7" C to C
288 Wheels 18"x5"
These 2 Lines of Wheels Identical with Third Line Above
80'
340 Wheels-6"x2"
15 Bench Polishing Lathes @ 4' C to C
12'
15 Bench Polishing Lathes @ 4' C to C
17 Bench Polishing Lathes @ 4' C to C 6"x2" Wheels
12'
16 Bench Polishing Lathes @ 4' C to C 6"x2" Wheels
12'
17 Bench Polishing Lathes @ 4' C to C 6"x2" Wheels
216'

FIG. 1. ARRANGEMENT OF POLISHING ROOM.

The design of the hoods deserves comment. In Fig. 2, the hoods are hinged at the back so that the entire wheel covering may be swung completely out of the way when changing wheels or truing. In many respects this is a decided improvement over the ordinary hood with the side door. The "undershot" wheels in Fig. 2 had to be provided with the other style of hood, because there was not room enough between the wheel and the branch pipe to permit the top of the hood to swing back.

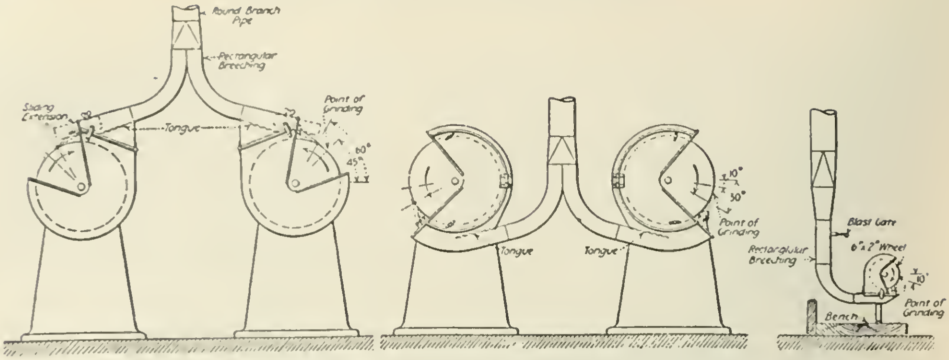


FIG. 2. DIFFERENT TYPES OF EXHAUST BREACHINGS.

Each of these hoods is so designed that the dust is thrown from the wheel directly into the mouth of the pipe. This gives a much better removal of dust than where the material is allowed to strike some part of the hood, losing the velocity acquired from the wheel. Each particle leaves the wheel at a mile-a-minute speed. If it can fly directly into the current of high-velocity air in the suction pipe, it will be removed with a minimum of external effort. If these bits of emery and metal are allowed to lose their initial speed by striking the side or back of a poorly designed hood, it will require a high vacuum and a strong blast of air to start them up the pipe from a state of rest. This is a recognized principle of hood design.

BALL-BEARING FANS

The large wheels are served by three large systems, each of which handles the dust from 96 wheels. The bench jacks are connected to four smaller systems along the side. In every case Oneida double exhausters, equipped with SKF ball bearings, are used. The construction of the blast wheel differs materially from standard practice. This is seen plainly in Fig. 3, which shows a small wheel with one side plate removed to expose the blading. When built in this manner the wheel is not only efficient, but extremely rigid. The use of high-grade ball bearings eliminates most of the ordinary fan troubles. The bearings are mounted in dust-tight housings, and when once packed with lubricant, need little attention.

WASHING THE AIR

The dusty air from each system is discharged into a pair of Gale centrifugal air washers, which thoroughly remove the dust, wash the air and return it to the room in a purified condition, entirely fit to breathe. Each double fan and pair of washers is erected as a self-contained unit, with water tank, strainer and pump. The small size of this unit as compared with the usual bulky dust collector is remarkable. But very little more floor space is taken up by the fan and washers than by the fan alone. The wash water is recirculated by a 1½-in. Goulds centrifugal pump belted to each fan. Each pump handles from 30 to 35 gal. per min. This is at the rate of about 1½ gal. per 1,000 cu. ft. of air, or about half that usually required by air washers. This is remarkably good economy when it is considered that the air washers at this plant are handling extremely dirty air. Several pailfuls of mud and lint are removed from the strainers every day.

Fig. 4 shows a plain view of one washer. The dirty fan blast enters at *A*, and in passing through the curved passage *B* the dust and lint are thrown against the curved outer surface of the washer, which is kept thoroughly wet by the three batteries of nozzles *C*. This effectively disposes of the heavier material, which is washed along the bottom to the drain connection to the strainer. In its passage through the outer washing chamber

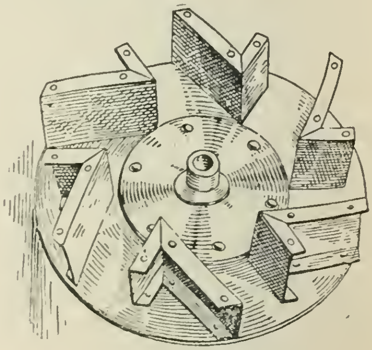


FIG. 3. BLAST WHEEL.

the finer dust becomes sufficiently moist and heavy to be thrown out of the air against the comparatively dry eliminating surface *E*. The sticky collection of mud on this surface is washed down by intermittent flooding from the nozzles *F*. The function of all sprays in this type of washer is to moisten the dust enough for it to be acted upon by centrifugal force and to keep the accumulated material washed from the curved surfaces. Very little dependence is place upon the direct wetting of dust by the sprays. As the name implies these washers depend upon centrifugal action for their best result. This is the reason why extremely dirty air is thoroughly cleansed with about half the volume of water ordinarily used for washing street air. After the washing operation the purified air is returned to the room through the outlet *D*, Fig. 4.

Owing to the close spacing of the double rows of jacks in the middle of the room, it was impossible to run the main-line exhaust pipes along the floor. A transverse power bridge of structural iron, from which the main motors were suspended, had already been erected. A timber deck on this steel framework provided a substantial footing for the three large double fans, washers and fan motors. This brought the center of the main-line pipes about 18 ft. above the floor, requiring vertical branch pipes 15 ft. long. Since it was not desirable to obstruct the floor space with pipe supports, the mains were slung from the roof trusses by cables and were guyed to the side columns. Along the sides of the room were structural bridges of the same height as the central one, carrying the shafting and pulley for the small bench polishers. At the proper points four smaller platforms were built on this bridge to accommodate the fans and washers. The motors for these fans were hung from the girders between columns, driving down to the fans at a 15-deg. angle. The main-line pipes for the small jacks were run along the top of the shafting support.

The preparation of the details shows considerable care. One of these points in particular, is the design of the small breechings by which each pair of wheels is connected to the branch pipes. Fig. 5 shows the construction of this piece. By making it of rectangular cross-section it is possible so to shape it that the two currents of air are flowing parallel at the junction point. This eliminates all losses due to eddies and interference of air currents, especially when one current is stronger than the other.

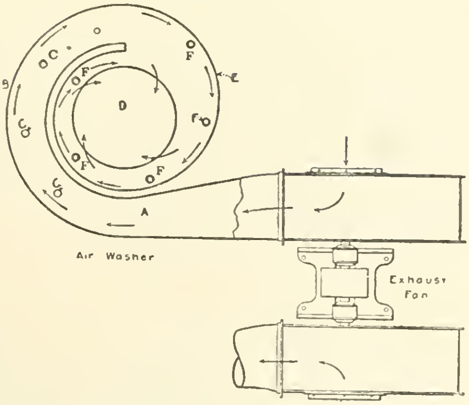


FIG. 4. PLAN OF AIR WASHERS.

All elbows and angles have a throat radius of two diameters of pipe and are made of metal two gages heavier than the corresponding suction pipe. A shorter radius than this causes too great a friction loss, whereas nothing is gained by using a longer radius, as experiments show that the reduction in friction is almost negligible beyond this point.

Vacuum, or "shoe," tees, Fig. 6, are used throughout as these have been found to give the most uniform result. They also have the advantage of providing a secure fastening, as they can be riveted to the main-line pipe on all sides. The ordinary 45-deg. round tee shows erratic pressure losses and cannot be riveted at the "heel," which makes an insecure connection. Each branch pipe is connected to the main-line tee with a detachable lug and bolt. This arrangement permits the branch pipe to be taken down without breaking a soldered joint, and at the same time a firm and solid connection is assured.

HAND HOLES FOR CLEANING

To facilitate cleaning, the main-line exhaust pipe is provided with hand holes at 10-ft. intervals. Each hand hole has a tight-fitting sliding cover, so that there is almost no leakage. The connection between the fan and the main-line is through a bolted joint fastened with angle-iron lugs and bolts. The removal of these bolts gives easy access to the interior of the fan through the inlet and also to one end of the main. The far end of the main is closed with a removable cap.

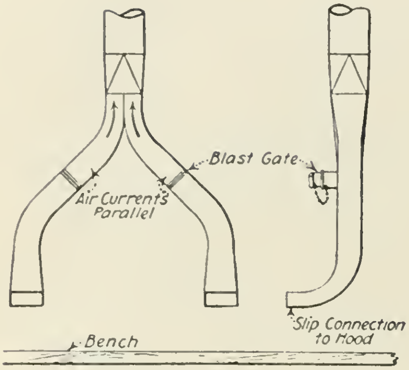


FIG. 5. BREACHING FOR BENCH POLISHERS.

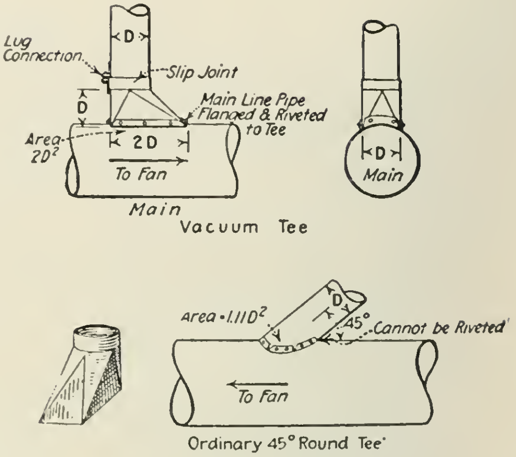


FIG. 6. VACUUM AND 45° TEES.

The galvanized steel used in the construction of the piping is of the following gages: For all pipes 12 in. and under, No. 24; 13 to 20-in., No. 22; 21-in. and larger, No. 20. All pipe is riveted and soldered, with the laps made in the direction of the air flow. Unusually heavy pipe supports of angle and band iron are used for holding the piping in place.

Particular attention was paid to the engineering features of the job. The pipe lines were designed for a uniform velocity throughout. A uniform vacuum of 2 in. of water is produced at each hood, the back pressure imposed by the dust separating and washing apparatus being reduced to a minimum. Competition was not allowed to influence the choice of the fan size or any of the important details. In a word, the entire installation was designed to produce the most economical operating conditions.

SAVING OF HEAT

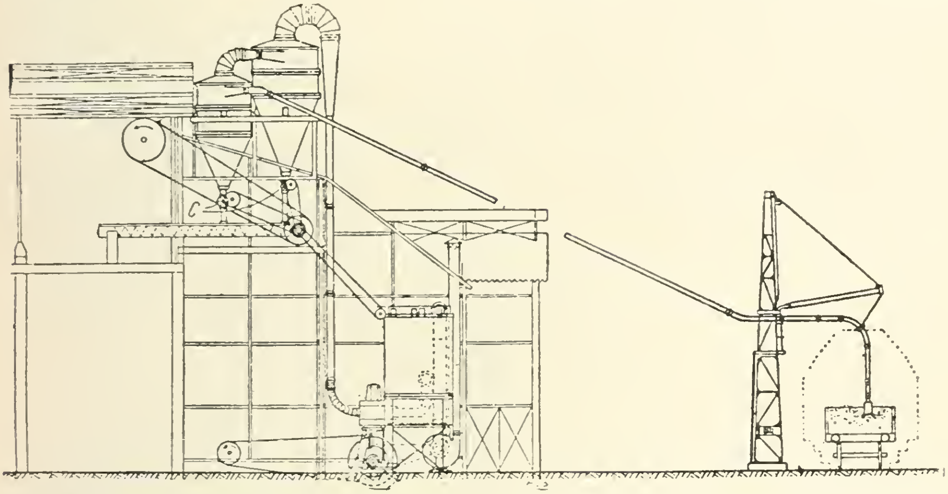
In this installation it was absolutely essential to provide some means of purifying the air and returning it to the room. The exhaust requirements were 180,000 cu. ft. of air per minute, and under the old method this would have been discharged into an outdoor separator. To heat this air costs about $3400 a year. Had this heat been wasted, it would have been necessary to provide 44,000 lin. ft. of 1-in. heater pipe in addition to that now installed. Aside from the extra heating cost and the additional pipe involved, a very important item was the physical comfort of the men. Had this great volume of air been removed from the room, it would have been almost impossible to provide comfortable working conditions in winter without objectionable drafts and considerable discomfort on cold days, a condition that would hardly have been permissible.

The argument may be advanced that the recirculation of this air in summer will create a close, humid condition. The plans are, however, to use Delaware River water as wash water during the summer, which will cool and dehumidify the air. It is possible to cool the air several degrees on a hot, moist day and to lower the relative humidity to a comfortable point when using cool water.

POWER CONSUMPTION

The power consumption of these systems is very low; 25-hp. motors drive the large double fans together with the recirculating pumps. These fans are equivalent in economical capacity to the ordinary No. 70 slow-speed double fan. The remaining exhausters, equivalent to No. 60 fans, are driven from 15-hp. motors. The vacuum produced is 3½ in. of water at the inlet of the large fans and 3 in on the smaller ones.

The refinement necessary to produce the required results with a minimum expenditure of power and to save the heat that would otherwise be wasted is fully justified, as it is paying well over 100 per cent. on the investment. The specifications were unusually rigid and were more severe than those of the state labor departments. A complete guarantee of horsepower, vacuum and back pressure was specified in the contract, and the whole was secured by a heavy forfeit. B. T. Converse, plant engineer of the Remington Arms Co., was responsible for the installation, and the fan department of the Oneida Steel Pulley Co. did the engineering and contracting.—*American Machinist.*



PNEUMATIC CONVEYOR FOR SLACK

The principle of the pneumatic conveyor, introduced (for grain) some 30 years ago by Duckham, has since been applied to other granular materials, including slack, owing to its convenience, the absence of dust, small space and little attention required. An installation of this type has recently been set up, at the works of the Deutsche Solvay Company, Bernburg, for discharging fine-grain brown coal from railway cars, which is accomplished at the rate of 15 tons per hour, without dissemination of dust, and without leaving any reminder to be removed by hand.

As shown in the illustration, an iron mast, set up by the railway track, supports a movable conveyor pipe by means of a jib. This pipe can be slewed, and can also be moved up and down by means of a winch at the foot of the mast. The suction nozzle terminating the pipe is guided to and fro by hand. From the mast, the conveyor pipe passes to a hopper, which is of large dimensions on account of the low specific gravity of the brown coal; and this hopper communicates with a second one (to the right), in which the dust arising from the coal is deposited. The mouths of both are closed by pocket-wheel valves C, which are kept in constant rotation to discharge the contents of the hoppers. A vertical air pump communicates with the conveyer pipe through the hoppers; and the discharged air is passed through a system of bag filters before being expelled into the atmosphere by a fan. A worm conveyor, underneath the valves C, delivers the coal to the fires. The same type of device might also be applied to the removal of ash and flue dust from producers, furnaces, etc.—*Stahl and Eisen.*

THE BIGGEST STACK

The largest stack in the world is located at Great Falls, the industrial and railroad distributing center of Montana. This stack is a part of the smelting plant of the Ananconda Copper Mining Company and is used to carry off the smoke and gases arising from the ore smelting plant below the hill on which this huge stack is built. The smoke passes through several flues into an immense dust chamber which has millions of wires hanging to collect the valuable mineral-charged dust, this chamber being the size of an average business block, after which it enters the flues leading up to the stack. The height of this wonderful piece of masonry is 506 feet, outside diameter at base 78 feet; inside diameter at base 55 feet. From these measurements our readers will see that the Washington monument which is 50 feet square at the base and 20 feet square at the top could be set inside of this chimney without touching any wall and there would still be room enough at any point between the wall to drive a span of horses. A brick plant was established on the ground for the purpose of furnishing brick, 16,000 tons of which were used in the construction of this immense chimney. The weight of the stack is 34,000,000 pounds and it was built to withstand a wind of 120 miles per hour velocity. This big chimney, if used as a manufacturing plant would be equivalent to a 42 story building, quite a skyscraper in these days of high buildings. From the top of this great structure one may obtain a wonderful view to the south of the Little Belt and to the east the peaks of the Rocky mountains.

PRESSURE AND VACUUM WOOD PRESERVING PLANT

BY EDGAR W. BRIGHT

The Boston Electrical Railway Company has recently completed a timber treating plant at its South Boston yard which is the first pressure installation to be built by any street railway in the United States, and it embodies a number of interesting futures. The plant is under the direction of the writer and the designing engineer is Grant B. Shipley, of Pittsburgh, whose patents are embodied. The plant is adapted to treatment by either the full-cell or the Rueping process. It represents an investment of about $30,000, and has a capacity when operating two charges per day in nine hours of about 210,000 ties of 7,000,000 ft. B. M. per year using air-seasoned timber and treating by the Rueping process.

The treating plant is located near the south end of the property and is mounted on a solid concrete foundation. The installation consists of two storage tanks, a treating cylinder capable of handling lumber up to 50 ft. in length, a pressure tank mounted on scales, vacuum pump and compressor equipment and other apparatus, together with an unusually flexible piping system. All of the principal equipment except the storage tanks is installed in a cylinder house shown in plan in Fig. 1, and in cross-section and elevation in Figs. 2 and 3. The housing is of corrugated iron on steel framework.

The plant is one of the few installations in the country in which a standard gage track is operated into the treating cylinder. It is far more flexible than the ordinary installation, besides being remarkably compact. Steam is supplied by a pipe line connecting directly with the company's South Boston generating station, and creosote is delivered to the storage tanks by automobile trucks, provision being made in the piping to empty the truck tanks by either 20-lb. air pressure or by vacuum. This enables the trucks to be completely emptied.

The storage tanks are each 22 ft. 6 in. long by 9 ft. 9 in. in diameter, their capacity being about 13,000 gal. each. They are mounted on concrete saddles and are installed with horizontal axes at right angles to the longer axis of the cylinder house. The piping connections enable either tank to be utilized in serving the pressure tank, and live steam coils are installed in each to protect the creosote from freezing in the winter season. Provision is made for the drainage of these coils through a valve beneath each tank which is left slightly open when in service. Each tank is equipped with a safety valve and a stop valve controlling the delivery of oil to the interior of the establishment. Piping connections are also provided for the introduction of compressed air into the storage tanks to insure rapid delivery of oil to the plant, and throughout the plant the creosote is handled by air pressure. The shells of the storage tank are of ⅜-in. flanged steel, the heads being of ½-in. steel. An 11-in. by 15-in. manhole is provided at each head end.

Two compressors are in use, both being steam-driven. Nearest the storage tanks is an Ingersoll-Rand "Imperial" type XI horizontal high-duty duplex compressor and air pump, with 7-in. by 7-in. by 10-in cylinders, mechanical inlet valves and flywheel. This is supplemented in high-pressure work by a Westinghouse air compressor capable of handling 29 cu. ft. of air per minute at 80 lb. pressure and delivering it at 200 lb. pressure when operated on a steam line pressure of 135 lb. per square inch. The piping enables the two compressors to be connected in series through valve manipulation.

The working pressure tank, 9 ft. 9 in. in diameter and 22 ft. 6 in. high, is mounted in the cylinder house on a Howe tank scale of the registering beam type, with 10-ft. by 10-ft. supports and graduations reading in 10-lb. steps. The scales are designed to carry a tank of 38,000 lb. steady load, and 120,000 lb. variable load of creosote, a total capacity of nearly 160,000 lb. The working pressure tank is equipped with steam coils for maintaining the

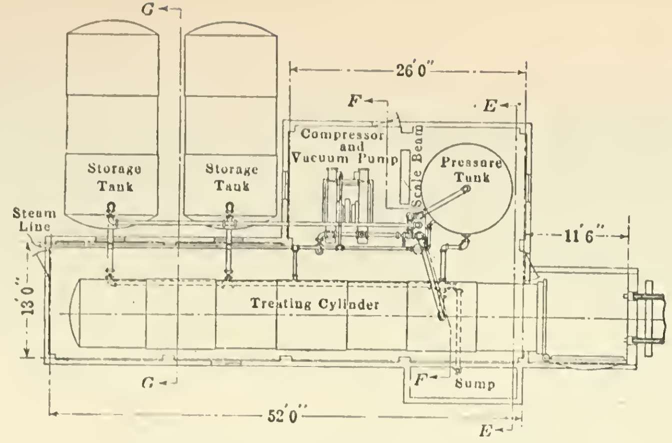
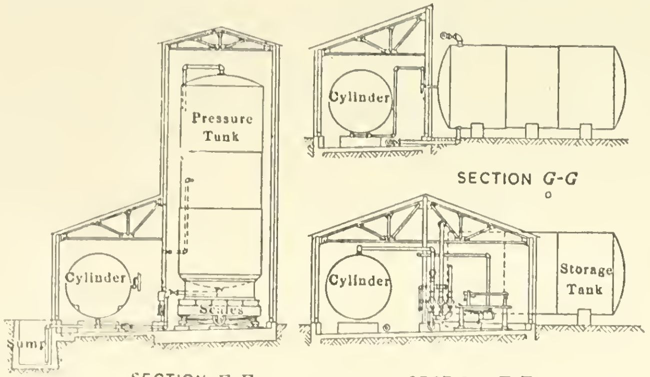


FIG. 1—PLAN OF CYLINDER HOUSE



SECTION G-G

SECTION E-E

SECTION F-F

For section lines see Fig. 4.

FIG. 2—CROSS-SECTIONS OF CYLINDER HOUSE

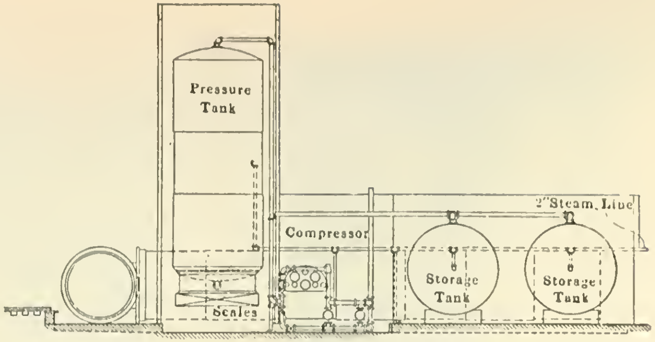


FIG. 3—LONGITUDINAL SECTION OF CYLINDER HOUSE

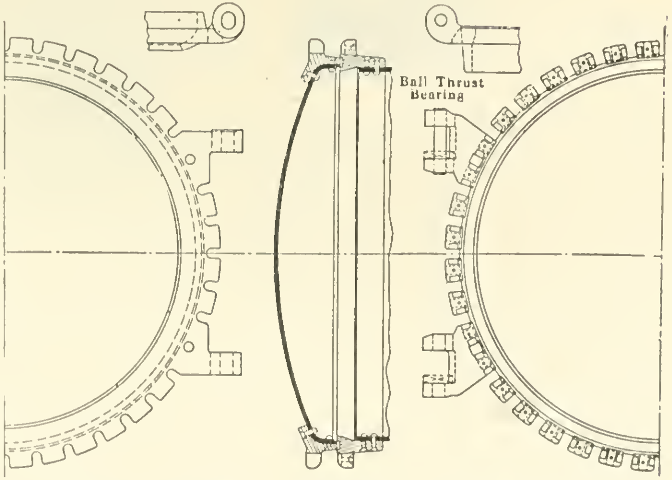


FIG. 4—DETAILS OF CREOSOTING CYLINDER DOOR

proper oil temperature. Its shell is of flanged steel plate 1-in. thick, the tank being designed to withstand a working pressure of 175 lb. per square inch, and a hydrostatic test of 265 lb. Ball-and-socket joints are installed in the air and oil mains leading into the tank, to care for the movement of the latter upon the scales as the creosote volume is changed.

The creosoting cylinder or retort is 7 ft. 6 in. inside diameter and 51 ft. 2 3-8 in. long. It has a shell of ¾-in. flanged steel made in seven courses or rings of one plate each. It is mounted on iron saddles resting on reinforced concrete foundations. The door, details of which are shown in Fig. 4, is located at the forward end. This has a steel frame of angle section bored accurately to fit the shell. The outer face of the frame is turned and grooved for a gasket. Fitting the frame and hinged to it is a heavy cast-steel door frame, to which is double-riveted a dished head of flanged steel, designed for a working pressure of 175 lb. and a test pressure of 265 lb. per square inch. The door is carried on two hinges supported by ball-thrust collar bearings. It is fastened by forty 2¼-in. T-head hinged bolts, each equipped with a steel washer and hexagonal nut. The door gaskets are of No. 600 "Ankorite" H. P. asbestos. The cylinder track consists of 4-in. x 4-in. x ¾-in. angles supported by six pressed-steel brackets per course. Fig. 5 shows a charge ready for insertion into the retort, the timber being mounted on special bolster trucks equipped with locking hoops. These hold about 10,000 ft. B. M. per charge, and tie cars hold about 420 ties per charge. The trucks are pushed into the retort by a service car equipped with an extra heavy bumper and loaded with discarded tie plates to provide the necessary traction. Charges are withdrawn from the retort by the same car through a wire cable attachment.

The full-cell process consists of impregnating the fibers and cells of the timber with from 5 lb. to 20 lb. of oil per cubic foot. In this operation the wood is either air-seasoned or steamed in the cylinder, sometimes both. This is done to reduce moisture and expel sap; then a vacuum is produced and maintained until the preservative is introduced and the wood is completely submerged. The pressure is then increased from 100 lb. to 150 lb. per square inch and maintained until the desired penetration has taken place, when the remaining oil is drained from the cylinder. Sometimes a vacuum is produced and maintained at the finish to drain the surplus oil from the outside surface of the wood to prevent loss of oil after the material is removed from the retort.

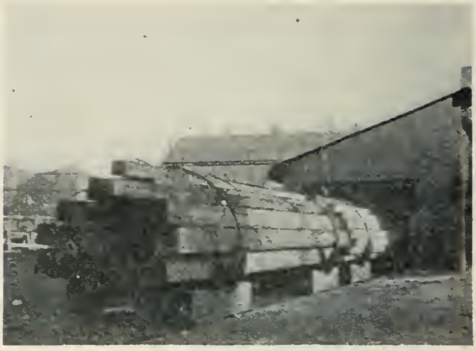


FIG. 5.

The Rueping or "partial cell" process consists of forcing compressed air into the pores of the wood; without releasing this air pressure, the oil is permitted to flow into the cylinder and air is displaced and forced into the top of the working pressure tank. After the wood is completely covered with preservative the latter is then forced into the wood to the required amount. The air pressure is then released and the preservative is drained from the cylinder. A vacuum is then produced which causes the air within the cells to expand and force fluid out of the wood, leaving from 4 lb. to 6 lb. per cubic foot. About 20 lb. maximum of air suffices to force oil from the storage tanks into the pressure tank. At the beginning of a run about 118,000 lb. of oil is in the working pressure tank. The oil temperature is usually about 170 deg. Fahr. before entering the retort. Steam coils are provided in the retort as well as in the other tanks above noted, and beneath the retort a sump about 9 ft. deep has been built to receive drained oil from the interior of the tank. This oil can be reclaimed by utilizing one of the compressors as a vacuum pump; in fact either pump may be operated on pressure or vacuum work, and the piping enables pressure or vacuum to be applied to either the retort or the working pressure tank as desired. An extra discharge pipe with check valve is also provided in the retort to enable sap, water, etc., to be drained into a blind drain in case the full-cell process is in use. This enables the steam supply to be kept on the coils within the retort throughout any desired period. Before the introduction of oil in the Rueping process, air at 60 lb. pressure is admitted to the retort for about forty minutes, in order to open the cells for subsequent treatment. The amount of oil absorbed is obtained by scale readings instead of by the customary and less accurate system of weighted floats. The auxiliary equipment includes a full set of Foxboro indicating and recording pressure and vacuum gages, thermometers, etc., and Crosby pressure gages. A complete system of records of all work handled is maintained.—*Condensed from Electric Railway Journal.*

BENDING RAILS WITH A PNEUMATIC HOIST

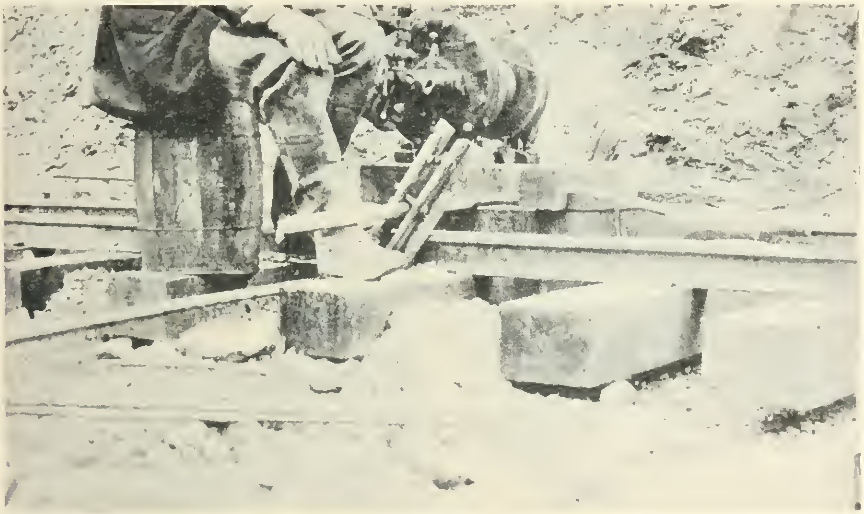
BY H. S. HICKS

The necessity for rail bending is not infrequent in mine-track work, and the usual method of cranking the rails through a rail-bending machine is a slow, back-breaking and sometimes a heart-breaking job.

The method of overcoming this condition at the surface plant of one of the Juneau (Alaska) mines, is interesting. Fifty-pound steel rails were being bent by hand with a three-wheel bender when the idea of using an air-operated "Little Tugger" hoist to pull them through was conceived. The rail bender was fastened on the track at a point where the curvature was approximately the same as that of the rails to be bent and the "Little Tugger" was placed a little more than a rail's length away. A rail was started through the bender and the hoist pulled it the rest of the way. The power required was of course considerable and when a curvature of short radius was required a block and tackle was sometimes employed, the hoist still doing the pulling but with a multiplied effect.

When cranking the bending machine by hand, eight men were able to bend but eight rails a day. With the assistance of the "Little Tugger," two men bent six rails per hour, the other six being kept busy carrying rails to and from the machine.

The hoist is bolted to a timber skid, as shown in the illustration. This arrangement is easily anchored in any of the many places where the hoist is used, and at the same time two men can easily carry it about, an ample air supply being always available.



SYSTEMATIC SUPERVISION OF MACHINE DRILLS

An interesting innovation in the management of machine drills under ground has been made at the Franklin mine, in the Lake Superior district. As many as eight machine drills are run in a row all supervised by one expert mechanic. This scheme could well be copied by other mines that have stopes sufficiently large to justify that number of drills. The advantages are obvious; the bunching of machine drills pleases the miners, who like company in their work, and it saves on supplies, and also in the matter of time in the correction of any minor difficulties that may arise. Although the machine runner in the Lake Superior District is of a superior type, nevertheless he cannot be expected to be as good a mechanic as he is a drill runner, and therefore the services of a mechanic at hand are of great advantage. Not the least benefit of such an arrangement is that it reduces to a minimum the likelihood of a drill runner losing his temper and hitting his drill with a sledgehammer, whereupon it immediately becomes a candidate for the drill hospital.—*Eng. and Min. Journal.*

CORRECT PRESSURES TO USE IN FAN TESTING

BY JOHN L. ALDEN

The literature of fan testing is incomplete in regard to the measurement and use of the various pressures developed by the fan. It is the purpose of this article to show, not how to measure the pressures, but what pressures to measure.

The mechanical efficiency of a fan or blower is the air horsepower divided by input horsepower. The input to the fan may be measured in any of the standard ways. The output, or air horsepower, of the fan depends on the volume of air handled and the difference in pressure produced by the fan. The volume is usually determined by the use of the pitot tube, anemometer, Thomas meter, orifice or venturi meter. The pressure measurements are usually made by the use of a pitot tube, piezometer ring or static-pressure holes in the circumference of the pipe. All these have been fully covered in textbooks and published articles and will not be discussed here.

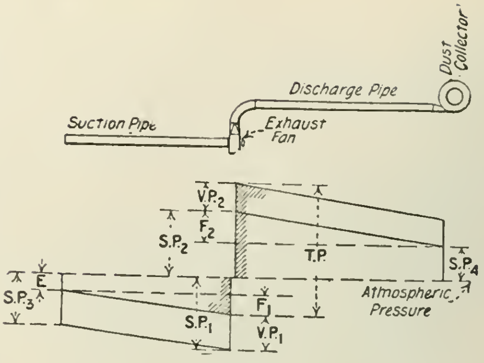


FIG. 1.

The total pressure existing at any point in a pipe is the algebraic sum of the static and velocity pressures at that point measured directly by the impact or dynamic orifice of the pitot tube. The dynamic pressure in the discharge pipe is always greater than atmospheric pressure and is therefore positive. In this pipe the velocity and static pressures are both positive. In the suction pipe the static pressure is always negative and greater, numerically, than the positive velocity pressure at the same point. For this reason the suction dynamic pressure is always less than atmospheric pressure and hence negative. The total pressure difference produced by the fan is the algebraic difference between the dynamic pressures as measured on the two sides of the fan as shown in the diagram, Fig. 1, where

$T.P.$ = Total pressure developed by fan;
$S.P._1$ = Static pressure at fan inlet—negative;
$S.P._2$ = Static pressure at fan outlet—positive;
$S.P._3$ = Static pressure at end of suction pipe—negative;
$S.P._4$ = Static pressure at entrance to collector—positive;
$V.P._1$ = Velocity pressure at fan inlet—positive;
$V.P._2$ = Velocity pressure at fan outlet—positive;
$F._1$ = Friction loss, suction pipe—negative static pressure;
$F._2$ = Friction loss, discharge pipe—positive static pressure;
$E.$ = Entry loss, suction-pipe inlet—negative static pressure.

This represents an exhaust fan drawing air through a suction pipe and discharging it into some sort of dust collector or receiver, through a discharge pipe of different diameter from the suction pipe. The discharge pressures are represented graphically as falling above the atmospheric line and the suction pressures below. The only pressures essential to the computation of the air horsepower of the fan are the two static and two velocity pressures measured at the fan. For a proper understanding of the composition of these pressures, the diagram has been extended to show the conditions at the ends of the suction and discharge pipes. The static vacuum at the mouth of the suction pipe consists of that part which produces the inlet velocity and

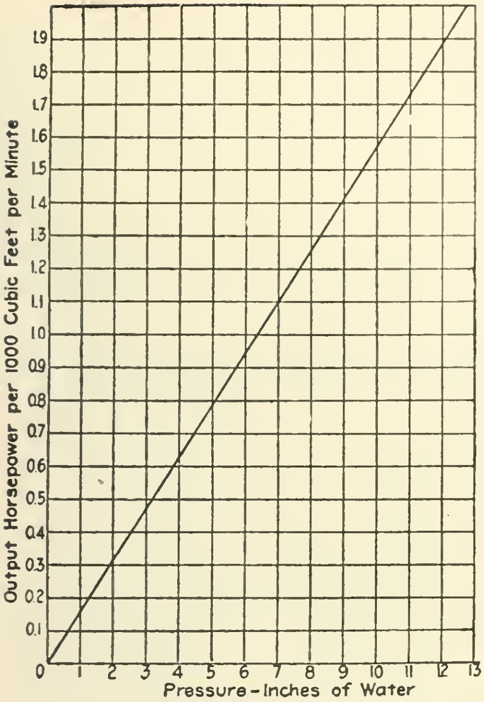


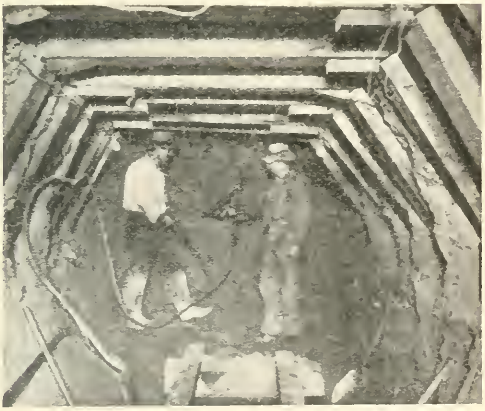
FIG. 2.

that necessary to overcome the entry loss due to the contraction of the liquid vein. The difference in static pressure at the two ends of the pipe is used in overcoming friction and eddy losses. The static pressure in the discharge pipe is that required to overcome friction and the resistance imposed by the dust collector.

A number of published accounts of fan tests give erroneous results and conclusions because the calculations are based on the wrong pressures. It is customary with many engineers to base their figures on the sum of the two static pressures and the discharge velocity pressure. As one velocity pressure has already been included in the static suction, it is plain that this method gives the fan credit for creating more pressure than it actually does. It is too high by the amount of the suction-velocity pressure, and consequently gives too high an efficiency. This method is correct only when the inlet velocity is zero, which never occurs when the fan is delivering air.

When the inlet and discharge pipes have different areas, the numerical sum of the two dynamic pressures must be used as the true total pressure produced by the fan. If the two pipes are the same size, the sum of the static pressures is identical with the sum of the dynamic pressures. If a correct test of an open-inlet blower is desired, it will be necessary to attach sufficient suction piping to enable the static suction to be measured. If accuracy is not essential, it will be necessary to figure the inlet velocity from the discharge velocity by using the ratio of the discharge area to the net inlet area. In addition, the loss at entry into the fan inlet must be estimated and considered as part of the static suction pressure. To do this it will be necessary to assume a coefficient of influx corresponding to the general shape of the inlet.

When the proper pressures and the volume of air have been determined, the air horsepower of the fan may be quickly found from the curve, Fig. 2, based on a 30-in. barometer and 50 deg. F.—*Power.*



EARTH TUNNELING WITH PNEUMATIC COAL PICKS

Labor cost of tunnel excavation was reduced one-third on Milwaukee sewer tunnel work by substituting pneumatic tools for hand picks and mattocks in cutting down the hard earth working face. The illustration here reproduced from The Contractor, Chicago, shows the work in progress with pneumatic chisels or modified coal picks.

The sewer built in tunnel was 78-in. circular concrete, filling the tunnel excavation. The tunnel was approximately 7,000 ft. long and was at an average depth of 75 ft. below street surface. About two-thirds of the work was in very hard clay and probably one-third in a material that would be called hard pan.

Shortly after the contract was taken, trouble in securing labor developed and wages went up. To meet the difficulty the use of coal picks was suggested to the contractor and he purchased twelve machines, using two in each heading and running four from each shaft with a 10x10 in. compressor.

The coal pick used was one of the ordinary pneumatic hammer type, as shown by the illustration, but having a chisel shaped cutter with a blade edge of about 3 in. and a blade bent like a shovel blade in respect to the stem or haft of the tool. In operation the workman held the tool so that a shaving of earth was peeled off the earth face.

Using the pneumatic tools two miners made an average of 8 ft. of tunnel per day. Previous to using the tools three miners were excavating 5 ft. of tunnel per day. The labor cost on the job was reduced 33⅓ per cent.

The contractor for the tunnel was the Wisconsin Tunnel & Construction Co., Milwaukee, Wis., A. F. Hewitt, president.

PRECAUTIONS IN BLASTING

Never open a metal keg of powder with a pick or metal tool. Use the opening provided by the manufacturer of the keg.

Never return to a shot that has failed to explode until at least 10 min. after lighting it, if squibs were used, or 12 hr. after lighting if fuse was used. When shots are fired electrically be sure that all wires are disconnected from the battery, and wait at least 5 min. before returning to the face.

Never allow powder or other explosive to remain exposed. Keep it in a well-locked box at least 100 feet from the working face and in an unfrequented place.

Never go near a powder box or powder when smoking.

Never allow the point of the drill to become dull or to become of less than the standard gage, so that a drill hole may be made with it into which the cartridge may always be pushed freely.

Never withdraw a shot that has missed fire. Drill a fresh hole at least 2 ft. from it but parallel to the old hole and fire this new hole. After the shot a careful search should be made for the unexploded charge to prevent its being struck by a pick and perhaps causing an explosion.

Never use iron or steel tampers or needles. Have at least 6 in. of hard-drawn copper on the tamping end of the bar or, better still, use a hardwood tamping stick. The needle should be made entirely of hard-drawn copper.

Never tamp shots with an iron or steel scraper, and do not push a cartridge into the drill hole with the scraper. The scraper rod should be tipped with at least 6 in. of brass or copper on the scraping end.

Never take more than one day's supply of explosives to the work at one time.

Never leave explosive on the work over night.

Never attempt to use frozen dynamite.

Never crimp a "cap" with the teeth. This practice is dangerous. Use the crimper.—*Miners' Circular 7a.*

GASOLINE SAVES THE LIFE OF A LINOTYPE MACHINE

The Oklahoman has this story to tell:

R. E. L. Brown, mechanical superintendent of the Oklahoma Publishing Co., did some quick inventing when news came of the break in the gas main Saturday. Fierce heat of gas jets is necessary to heat type metal in the linotype machines. Gasoline flames are the only substitute for gas flames in heating type metal. The linotype machines are not equipped with gasoline attachments because the gas supply is supposed to be as constant as the coming of night and day. So invention was needed.

Brown rushed to a hardware store just before closing time Saturday night and asked for gasoline burners or gasoline stove fixtures. We don't carry 'em," he was told.

"Give me two gasoline stoves!" Brown demanded. He got them. Then he bought eight gasoline torches, the kind the patent medicine show man swings from a pole to draw crowds at night and illumine the negro banjoist. Back in the composing room of the Oklahoman plant, Brown and two assistants began to apply the torches and gas stove burners to the linotypes. A linotype machine is a complicated mechanism. Attachments must be complicated. But in an hour one machine was turning out lines of type under the action of the gasoline burners. Then one by one seven machines were put into action.

Coal grates were hurriedly placed beneath the huge pot which melts the metal for the stereotyping machinery. The linotypes clattered. The forms of type were rushed to the stereotyping room, the plates were made and rushed down to be clamped upon the presses. The boss pressman turned the switch and the first edition rolled off on time.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

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BARGAIN TIME

The fullness of the heart compels the mouth
To speak, and wonted themes must wait awhile.

The time has come when we must make our stand
For many things which never until now
Had need of guarding hand. We went along
Pursuing each our self-planned schemes, though still
With help of each for each, and not without
The rivalry that spurs all to their best.
Until this darksome shadow sharply fell
There never was a time when all the earth,
Well filled with comfort and content,
Could look so trustfully on days to come.

It must have been a dream, for suddenly
'Twas all upset and horror and dismay
Began to flood the earth. The peaceful arts
Gave way to war's demands. The industry
Which for so long had toiled to clothe and feed,
To brighten and to smooth the path of life,
Was turned instead to sow grim seeds of death,
With crop of desolation and despair.
The fiendish boast may now be surely made
That blacker, bloodier page was never writ.

America we thought might still be safe
To be a mere onlooker, though with teeth
Tight clenched as raged the wanton wickedness;
But this was not to be. No place appears
For us to stand aloof. The world is one,
And we are in and not outside it, while
Our schemes and interests touch all mankind.

A constant interchange of things which each
Has better than the other helps us all.
Across the seas we have both bought and sold,
With many friendly visits back and forth;
But this must all be stopped on pain of death!
Almighty God perhaps might make such threat,
For reasons that to us did not appear,
But who on earth has impendence so vast
To arrogate the claim

The record stands
Incredible but true, the word swift matched
By deeds which we could not believe
Were possible for man to plan and do.

It is a world-surprise whose ruthlessness
Still has its swing. And this to face and down
Is straight before us as the only way.
Our duty never is experiment,
But always what both can and must be done,
And in the end, though near or far, it wins,
And is the one thing sure.

Our thought is all
Upon the present and the future, with
No slightest plan for righting what is past
Or dealing punishment where well deserved,
We are to be diverted by no plea,
Divided by no claim of fatherland
Across the sea, which we have rightly loved,
It is our homeland and our children's land
That stands supreme.

We know not what the price
We yet must pay to make our homes and lives
Secure, the time required to crush and grind
And utterly annihilate the crew
Now raging wild; but we can pay the price
And we can bide the time to make us sure
Of bargain everlasting. R.

NEW BOOKS

Mechanical World Pocket Diary and Year Book, Manchester, England, Norman Remington & Co., Baltimore, Md. 450 pages, 4 by 6 in. Price $0.35.

This compact volume, now in its thirtieth year of publication, comprises an extensive collection of handy tables and various useful data for engineers and mechanics in general, kept up-to-date from year to year. It of course contains numerous advertisements which alone make its publication possible, but including these it is handy to have and convenient for the pocket.

Income Tax Procedure, 1917. By Robert H. Montgomery. The Ronald Press Co., New York, 470 pages, 6 by 9 in. Price $2.50.

This book, though not devoted to the topics with which we are most familiar, cannot fail to be of interest to many of our readers. Those who look into it will be likely to look deeper on account of the surprising complication of the problem considered, and those of us who are so fortunately unfortunate as to come under the exactions of the law will welcome the information and the suggestions it contains, especially as to what does and what does not constitute income in the eyes of the law. Mr. Montgomery characterizes the existing income tax as most vicious, in that it encourages Governmental extravagance and removes accountability for it.

LUBRICATION AND CARE OF PNEUMATIC TOOLS

A booklet recently issued by the Chicago Pneumatic Tool Company deals with the above important topic. It is pointed out that unless pneumatic tools are kept clean, well lubricated and limited to the uses for which they are intended, they will not give the service for which they are designed. To keep the working parts of the tools clean and free from particles of foreign matter, the first thought should be given to the air itself. Wherever possible, the air supply should be drawn from some point outside the building where the air is most apt to be clean, cool and dry. In any event, a strainer should be placed over the exposed end of the inlet pipe. Such a strainer can be easily made by covering the opening with wire netting over which one or two layers of muslin have been placed. While under ordinary conditions the strainer is not essential, it helps to avoid a great many possible lubrication troubles, and not only adds to the life of the valves, piston and glands of the air compressor, but assists in keeping the dirt and grit out of the working part of the tools.

[In this connection it should be pointed out that to put a wire netting over the end of the intake pipe, and especially to cover the netting with muslin, would be to choke the intake and materially reduce the volume of air compressed and delivered per stroke. The air filter or strainer should be a hood or box of any convenient shape but with a surface area much greater than that of the pipe section. Arrangements should also be made for washing or otherwise cleaning the filter surface from time to time].

A strainer should also be placed in the pipe lines leading directly to the pneumatic tools, and special strainers are made to insert between the pneumatic hammers and the hose nipple.

OIL PARTS FREQUENTLY

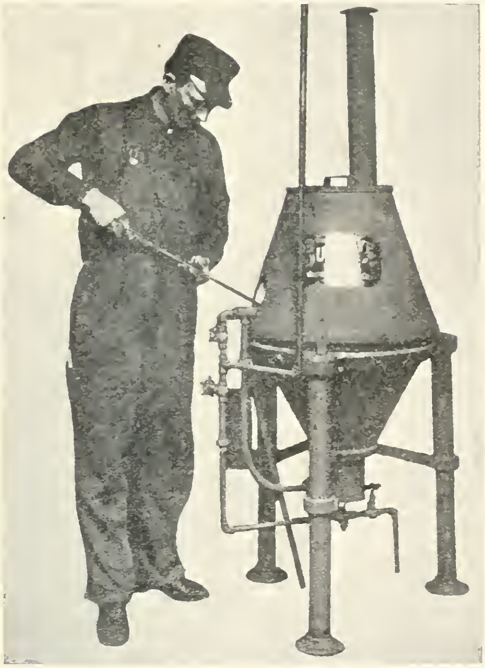
In the lubrication of pneumatic tools, judgment should be used, for there are some machines or portions of them that require a light machine oil and others that require a heavy grease. Valves and pistons for both hammers and drills require a light machine oil, and as the compressed air which comes in direct contact with these parts has a tendency to drive the lubricant out through the exhaust, it is advisable to oil such parts freely and often, about once every hour while the tool is in constant use. Such portions of the tools as the gear and crank cases to which the compressed air does not have direct access are best lubricated with grease. This grease may be forced into the crank cases through the dead air handle by means of a squirt gun or syringe. A filling every 10 hours while the drills are in constant use gives the best results.

It is a good plan to immerse pneumatic hammers in a bath of benzine or kerosene over night and then blow them out under pressure the following morning, after which they should be thoroughly lubricated, with a light machine oil.

COMPRESSED AIR IN METAL PRESS WORK

Many up-to-date shops use compressed air in the press rooms. It may be supplied by piping that connects the compressor tanks with each machine, or by a small pumping attachment bolted to the main casting of the machine. While compressed air is rather expensive, its great cost-reducing powers and economic value in shop manufacturing operations, especially press work, more than offset the first cost. It may be used for removing work from dies, blowing work through open-back presses into work boxes, removing work from certain style jigs in the drill press, keeping dies free from scale, chips, and dirt, removing punchings from tapped holes, furnishing power for automatic feed devices and for the side stroke in double-action dies; it has also been used as a bumper pad for the pressure ring in shell-drawing dies.

In looking through the Patent Office Gazette each week we note some interesting things. Here, for instance, is the entire claim to cover a new process for preserving eggs:—"The process of preserving eggs, the same consisting in immersing the eggs in a solution of *Desmodium tortuosum meibomia* in proportions of substantially one pound of *Desmodium tortuosum meibomia* to one gallon of water."



A SAND BLAST FILE SHARPENING MACHINE

The illustration shows a special file cleaning and sharpening machine built by the Macleod Company, Cincinnati. It uses compressed air, preferably not under 80 lb. pressure, and a special flint abrasive which can be used over and over again, the waste being replacable at reasonable cost. A blast of air from a fixed jet within the head and carrying in suspension the abrasive flint is directed upon the file which is thrust in through an opening in the front. The angle at which the file is introduced is fixed by guides just inside the opening. The file is pushed slowly into the drum and withdrawn a few times, the number depending upon the condition of the file. The abrasive, after striking the file surface at the proper angle, taking away all foreign material and leaving the file clean and sharp, drops into the bottom of the drum. It is then ready to be siphoned up by the jet and used over again. The apparatus can be used also as a sand blast for small castings, a hand-hole in the top being provided through which the castings may be introduced.

THE FUNCTION OF HIGH AIR PRESSURES IN BESSEMER CONVERTERS

BY W. TRINKS*

Practice has settled on blast pressures of 20 to 30 pounds per square inch for converters. Among those who are not thoroughly familiar with converter practice the impression prevails that this high pressure is necessary to deliver the air against the pressure caused by the liquid iron (ferrostatic pressure). Calculations based on actual converters show, however, that ferrostatic pressure at the bottom of the vessel varies between the units of 3 to 5 pounds per square inch, so that the question arises: Why the other 17 to 25 pounds? For the purpose of solving this question a test apparatus was installed in the Mechanical Engineering Laboratory of the Carnegie Institute of Technology.

Among the theories advanced for the necessity for the high blast pressures is the contention that the excess pressure is needed to keep the molten iron from flowing down into the tuyeres. It is well known that air and liquid of equal pressure, filling a pipe, will arrange themselves so that the liquid is at the bottom. It has been claimed that the iron would flow back, if it were not for the very great speed with which the air flows upward through the tuyeres.

In order to test this theory, the 6 in. pipe constituting the experimental converter was filled with mercury to such a height that the pressure at the bottom, that is to say at the mouth of the tuyere, was 4 pounds per square inch. The tuyere was 21 in. long, with a diameter of ½ in. The converter tube was righted from horizontal to vertical position with a pressure of about 10 pounds per square inch. The pressure was then gradually reduced, until the mercury ran back through the tuyere. This point was determined by the appearance of the mercury in a gage glass under the tuyere. Much to the surprise of the observers, the mercury did not appear in this gage glass until the pressure had been lowered down practically to that exerted by the mercury at the mouth of the tuyere, that is 4 pounds per square inch. The experiment was repeated several times by different sets of observers, and with different depths of mercury. The result was invariably the same, namely that the mercury did not run back through the tuyere until the air pressure equaled the static pressure of the liquid. It is therefore apparent that with openings as offered by the standard tuyeres (½ to ⅝ in.) the high blast pressures now in use are unnecessary as far as preventing the running back of the iron is concerned.

And yet experience teaches us that high blast pressures are necessary for successful converter operation. Some information on the reasons for such necessity can be gained by watching the mercury in the Carnegie Tech. installation while air is being blown through the metal. If the blast pressure is gradually increased, the behavior of the mercury in the tube changes remarkably. With low pressures, say from five to ten pounds per square inch, bubbles of air rise through the liquid, giving it the appearance of a liquid boiling in an open vessel. With 12 to 15 pounds pressure, chunks of mercury fly up 2½ to 3 feet, but they are still compact. As the pressure rises to 18 pounds or thereabouts, the mercury spouts at times to a height of 4 or 5 feet. The liquid is no longer compact, but is in the shape of drops anywhere from ⅛ to ⅝ in. diameter. As the pressure is increased to 22 pounds, the drops become smaller, and at 30 pounds the mercury is so well atomized that at times it appears like a gray mist of fine globules of metal. The spray of drops rises to more than 12 feet. How much more, we do not know, because it leaves our tube. However, very little mercury escapes, because a cloth bag, tied fast to the end of the tube, catches the spray. What little escapes is very finely subdivided and might almost be called mercury vapor. For reasons of health of the observers the pressure of 30 pounds per square inch is not kept on the apparatus very long. Besides, the whole apparatus shakes violently at the high pressures, because practically the whole body of mercury rises and falls intermittently.

It is evident from these tests that higher and higher blast pressures mean finer and finer subdivision of the liquid iron in a conventer. Low blast pressures mean large bubbles of air which escape, before their oxygen has been entirely absorbed by the iron. Blast pressure should be high enough, and the subdivision of air and metal should be carried far enough, until the discharged gases are free from oxygen. Additional subdivision will serve no useful purpose.

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*Prof. Mech. Engrg., Carnegie Inst. of Technology.

Converter practice then had to decide between large quantities of air at low pressure, or smaller quantities of air at high pressure. As we pass from low pressure to higher pressure, subdivision of air and metal becomes finer and finer, but the gain becomes smaller and smaller. Finally a loss appears, because first, blast pressures become excessively high, which fact means useless power consumption, and second, because too much metal is lost through the mouth of the converter. Practice has shown that the practical range extends from about 22 pounds to about 32 pounds per square inch, depending upon the size of the converter.

The results of the Carnegie Tech. tests while made on a small scale, are nevertheless representative, because opening and length of tuyere coincide with those used in practice, and because the ratio of tuyere area to cross sectional area of converter is the same as used in practice, namely approximately three-fourths of one per cent. A slight difference may come in from the fact that the viscosity of molten iron probably differs from that of mercury. Furthermore tuyere length changes in practice because tuyeres burn down from almost two feet length to less than 10 in. length in six to eight hours. But none of these differences can seriously affect the mechanical effect of air of different pressures upon liquid metal, so that, as before stated, the experiments with the mechanical converter at Carnegie Tech. may well be taken to depict what is going on in the actual metallurgical converter.—*Blast Furnace and Steel Plant.*

NOTES

The engine of an automobile standing in a garage was started as usual for the purpose of warming it preparatory to starting out. The flywheel exploded killing one man almost instantly and fatally injuring another. Parts of the machine were thrown over 60 feet effecting noticeable damage to a box car on a siding.

A process for using compressed air for hardening steel, where only portions of metal require treatment, has been invited by a metallurgist in Germany.

Natural gas to the extent of 628,578,842,000 cu. ft. was used in the industries in the United States in 1915.

Sulphuric acid to the amount of 100 tons is being made daily at the Garfield smelter from the fume. This formerly went to waste through the stack.

The cement gun was used with success and satisfaction for the cement lining 1¾ in. thick applied with an air pressure of 35 lb. gage, to the interiors of five large steel smoke stacks recently built for the Ford Motor Company, Detroit.

I can add to your troubles, I can subtract from your earnings, I can multiply your aches and pains, I can divide your attention, I can take interest from your work and discount your chances for safety.—*Carelessness.*

In Trinidad a lone sugar factory gave up the ghost some years ago, the machinery was dismantled and some of the plant torn down. The chimney, however, was left and now a tree has grown up inside of the chimney and the inhabitants are greeted with the remarkable spectacle of branches coming through the cracks.

A vast increase in the production of gasoline from natural gas resulted from expansion of the casing head gasoline industry during the last calendar year. During the year 65,364,665 gallons of raw gasoline was extracted, a gain of 22,712,033 gallons, or 53 per cent. over 1914.

Aeroplane metal is the name of an aluminum alloy patented in England. The patent specifications give its composition as follows: Magnesium, 6.5 to 15 per cent.; cadmium, 2.5 to 10 per cent., and aluminum, 91 to 75 per cent.

The making of permanent magnets is a new Sheffield industry as a result of the war. Not only small magnets, such as are used in magnetos, electric meters and ships' compasses, but one of the largest steel firms is busy making large electric magnets for lifting iron and steel material.

The Engineering Association of the South is to discontinue its existence, the members having decided that there is no place for a society that is neither broadly national nor purely local. The Nashville section of the society, with 150 members, will become the Nashville Engineering Association, and other sections may follow this plan of evolving into local societies.

As showing the great difference in surface area between relatively fine and coarse sands and dust, it has been calculated that a pound of sand deficient in the finer fractions contains 129,030,065 particles, having a surface area of 44,378 square feet. A finer sand was found to contain 232,075,324 particles to the pound and had 60,503 square feet of surface, while a pound of dust was found to consist of 192,715,378,500 particles, representing 527,821 square feet.

A large order for "Imperial" electrically-driven air compressors has been placed with the Ingersoll-Rand Co. of New York, by the Chicago headquarters of the Standard Oil Co. It is planned to install these at some 65 of the latter company's supply stations in that locality. Free air at gas stations is a convenience that benefits both car owner and gasoline seller.—*Gas and Oil Power.*

The most successful acid-resisting alloys are those of iron and silicon containing 14 to 15 per cent. of silicon. According to a paper read by Mr. W. C. Carnell before the American Institute of Chemical Engineering, such alloys resist the action of nitric and sulphuric acids of all strengths, and also are proof against atmospheric corrosion. In the acid industry this alloy is much more efficient than stoneware.

Forty-five men enrolled in the 20th annual three-months' mining session at the College of Mines, University of Washington, Seattle. Their ages vary from 21 to 56 years, averaging 32 years. All but ten of the men have had mining experience. They register from all parts of the Pacific Coast, from Arizona to Alaska. Quartz miners are in the majority, but several placer miners are present, also a few coal men.

It would seem the wiser policy to leave the adoption of the metric system optional, as we and our American cousins have done hitherto, till the civilized nations have agreed upon a really correct unit. Anyone who travels in the countries where the metric system is in force knows that in common practice it is not universally adhered to, but that the old measures and weights are still used by the masses. —*The Engineer,* London.

A compressed air tank in the West Salem (Wis.) Motor Co. garage exploded, causing much property damage and the serious injury of several persons. The tank was guaranteed to withstand a pressure of 200 pounds, but is said to have burst at 180. With the high pressures now demanded for charging heavy tires the margin of safety should have been considerably higher than here indicated. There is no suggestion that any safety valve was provided.

Four tunnel workers in the West Side Water Intake Tunnel, Cleveland, O., were awarded hero medals by the Carnegie Hero Fund Commission for bravery in rescue expeditions after the gas explosions in the crib heading of the tunnel on July 24. The tunnel at that time was full of afterdamp and marsh gas, and in two rescue parties ten or twelve men perished by asphyxiation. The four men who received medals went into the tunnel several times while it was in this dangerous condition, and rescued a number of members of the parties overcome in the tunnel.

The velocity with which sound travels through water is more than four times as great as through the air. As long ago as 1827 the sound of a bell under water was transmitted over 21 miles.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JANUARY 2

1,210,468. MILKING-MACHINE. Samuel B. Harner, near Xenia, Ohio.
1,210 522-3-4-5. VACUUM CLEANING DEVICE. William V. Orr, Cleveland, Ohio.
1,210,538. AIR-GAGE FOR TIRES. Elias B. Rose, Minneapolis, Minn.

1,210,564. PNEUMATIC FEEDER FOR THRESHING-MACHINES OR THE LIKE. Eddie D. Thorp, Dodge City, Kans.

1,210,679. INTERNAL-COMBUSTION METHOD OF FORCING OR COMPRESSING FLUIDS. Pontus Ostenberg, Los Gatos, Cal.

1. The method which consists in forcing liquid into a cushion chamber containing a fixed elastic fluid cushion by means of internal combusion of air and fuel, maintaining liquid in said cushion chamber at an approximately uniform pressure by means of internal combustion of air and fuel, and utilizing the liquid in a continuous stream from said cushion chamber to force or compress fluids by means of a continuous jet or jets of said liquid.

1,210,713. VENT-VALVE FOR TRAIN STOPS. Hiram G. Sedgwick, Mill Valley, Cal.

1,210,730. COMPRESSION AND SUCTION DEVICE. James B. Vernon, Pittsburgh, Pa.

1,210,747. DRILL. Frank R. Williams, Ottumwa, Iowa.

1,211,049. FLUID-OPERATED PERCUSSIVE TOOL. Lewis C. Bayles, Easton, Pa.

1,211,074. REGULATOR FOR FLUID-COMPRESSORS. Emery L. Bulkley, Painted Post, N. Y.

1,211,161. WIND-POWER. Toshihei Jikihara, Uplan, Cal.

1,211,169. ROTARY COMPRESSOR. Charles Edmund Kells, New Orleans, La.

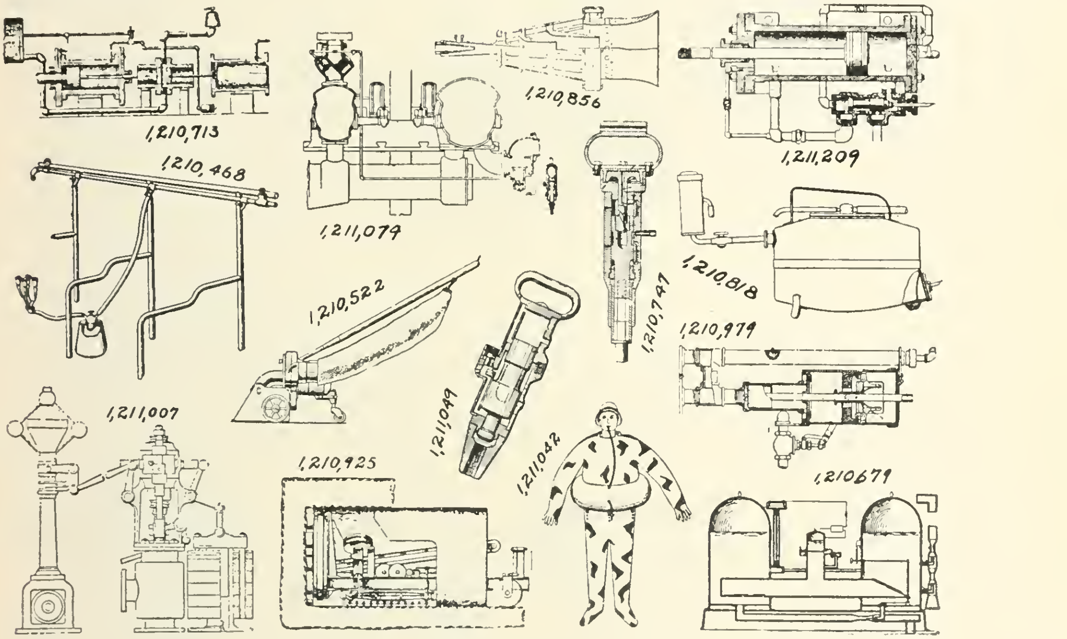
1,211,209. FLUID-PRESSURE MOTOR. Edward W. Meredith, Bloomsburg, Pa.

JANUARY 9

1,211,495. VACUUM GOLD-SEPARATOR. William Shore, Montesano, Wash.

1,211,636. AUXILIARY AIR-SUPPLY FOR INTERNAL-COMBUSTION ENGINES. William B. A. Spray, Vancouver, British Columbia, Canada.

1,211,647. APPARATUS FOR ADMINISTERING ANESTHETICS. Will P. Walter, Chicago, Ill.



PNEUMATIC PATENTS JANUARY 2.

1,210,818. MILK VESSEL FOR MILKING-MACHINES WORKING WITH VACUUM. Knut Ivar Lindstrom, Djursholm, Sweden.

1,210,846. BRAKE MECHANISM. Frederick Henry Royce, Derby, England

1,210,856. HYDROCARBON-BURNER. James E. Sheaffer, Burnham, Pa.

1,210,925. TUNNELING-MACHINE. James C. French, Kenosa, Wis.

1,210,939. RESPIRATING DEVICE. Martin Hilgers, Tazewell county, Ill.

1,210,979. PRESSURE OR VACUUM CONTROLLED TRIPPING MECHANISM. Reginald J. S. Pigott, Bridgeport, Conn.

1,210,981. OIL-BURNER-AIR-SUPPLY REGULATOR. George A. Pingree and Richard A. Uhlin, Seattle, Wash.

1,211,007. GOVERNOR MECHANISM FOR COMPRESSOR-ENGINES AND THE LIKE. Moses Edward Teague, Cinderford, Gloucester, England.

1,211,042. LIFE-SAVING SUIT. Gergely Balogh, Detroit, Mich.

1,211,665. ATOMIZING WATER-SUPPLY MEANS FOR INTERNAL-COMBUSTION ENGINES. Benjamin B. Block, Los Angeles, Cal.

1,211,736. APPARATUS FOR DISINTEGRATING SHAVINGS. David E. Marshall, Kansas City, Mo.

1,211,786. VACUUM-CLEANER. Horace H. Taylor and Leonard A. Moberry, Oakland, Cal.

1,211,846. PNEUMATIC BED FOR HIDE AND LEATHER WORKING MACHINES. Henry A. Holder, Lynn, Mass.

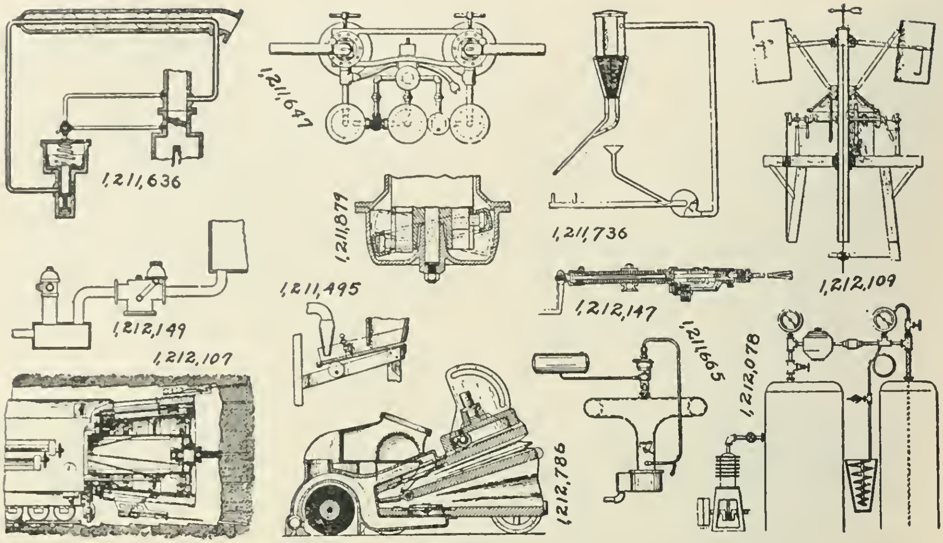
1,211,879. ROTARY PUMP OR BLOWER. James Robertson, Leytonstone, England.

1,212,078. OIL-SUPPLY SYSTEM FOR BURNERS. Henry G. Liebzeit, Sheboygan Falls, Wis.

1,212,107. TUNNELING-MACHINE. Dighton A. Robinson, Seattle, Wash.

1,212,109. WIND-MOTOR. Ernest C. Rodwick, Santa Barbara, Cal.

1,212,141. HAMMER ROCK-DRILL. Walter E. Kimber, Harlesden, London, England.



PNEUMATIC PATENTS JANUARY 9.

1,212,149-50. FLUID-METERING SYSTEM. George Goodell Earl and Albert Baldwin Wood, New Orleans, La.

JANUARY 16

1,212,193. APPARATUS FOR REMOVING SUSPENDED MATTER FROM GASEOUS FLUIDS. Henry L. Doherty, New York, N. Y.

1,212,393. PNEUMATIC CONCENTRATING-TABLE. Clarence Q. Payne, New York, N. Y.

1,212,455. SEPARATION OF THE CONSTITUENTS OF GASEOUS MIXTURES. Georges Claude, Paris, France.

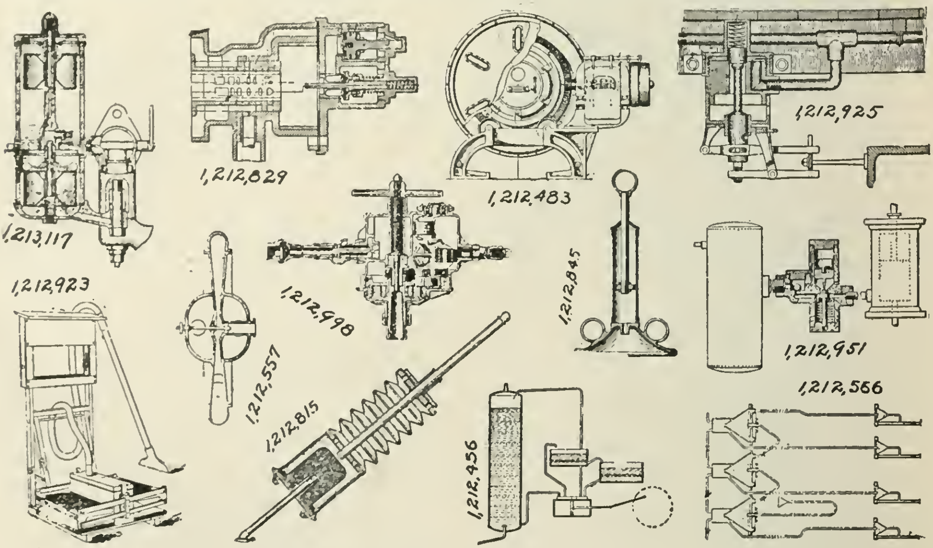
1,212,456. PURIFICATION OF GASES. Georges Claude, Paris, France.

1,212,483. VACUUM-CHURN. Ernest B. Heller, New York, N. Y.

1,212,557. APPARATUS FOR MIXING AND CONVEYING FLUIDS. Jean Alexandre Rey, Paris, France.

1,212,566. SEPARATING FINELY-DIVIDED ORE MIXTURES IN VACUUM SEPARATING VESSELS OR CHAMBERS. Friedrich Arthur Maximilian Schiechel, Frankfort-on-the-Main, Germany.

1. The Process of separating ore pulp, which includes subjecting a collection of such pulp to a vacuum sufficient to remove part of the metallic particles, and then subjecting the



PNEUMATIC PATENTS JANUARY 16.

collection to another and higher vacuum to remove metallic particles remaining after the first removal.

1,212,815. DOMESTIC CLEANING APPLIANCE. Carl Herrmann Roth, Southport, England.

1,212,829. AIR-BRAKE-CONTROL VALVE. Jacob Rush Snyder, Pittsburgh, Pa.

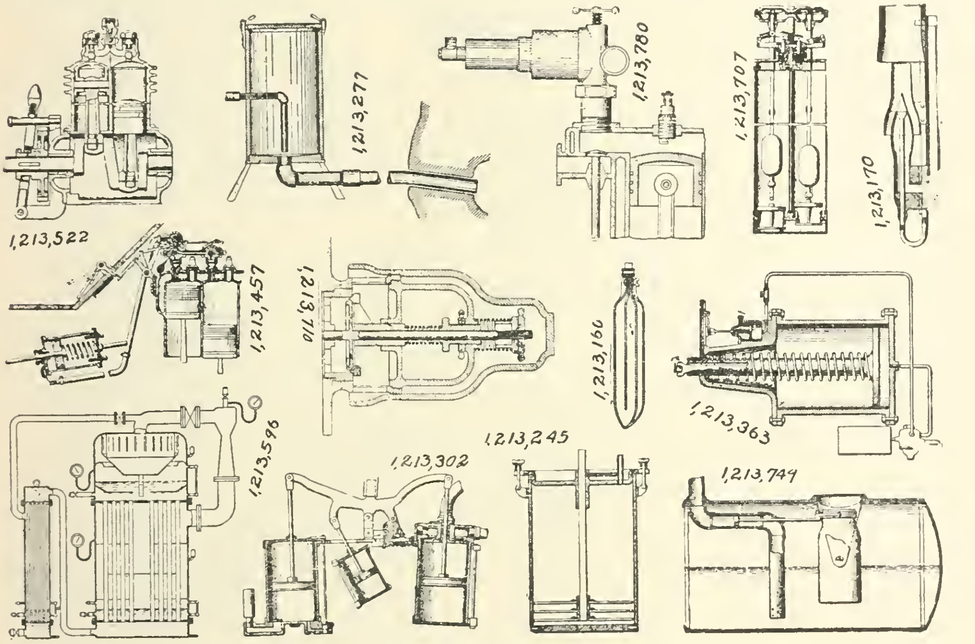
1,212,845. MASSAGE APPARATUS. Edwin R. Talley, Grinnell, Iowa.

1,212,923. PUMPING MECHANISM FOR VACUUM-CLEANERS. Andrew J. Faucher, Wichita, Kans.

1,212,925. AIR-PROOF COMPOSITION. Walter O. Fleckner, Cloverdale, Cal.

1. The hereindescribed process of producing a plastic composition for forming an air and liquid tight joint or connection which consists in cooking together resin and tallow until the ingredients are well melted, allowing the mixture to cool and then beating the mixture until it assumes a white color.

1,212,945. VACUUM SERUM-EXTRACTOR. Thomas P. Haslam, Manhattan, Kans.



Pneumatic Patents January 23.

1,212,951. RELIEF-VALVE FOR COMPRESSOR SYSTEMS. Arthur O. Higinbotham, Worcester, Mass.

1,212,955. SAFETY AIR-BRAKE VALVE. William S. Ingram, Raleigh, N. C.

1,212,975. ELASTIC-FLUID TURBINE. John A. MacMurchy, Wilkinsburg, Pa.

1,212,998. FLUID-MOTOR DRILL. Caid H. Peck, Athens, Pa.

1,213,117. VACUUM FEED DEVICE. Oscar L. Loughead, Racine, Wis.

JANUARY 23

1,213,160. BREATHING-BAG. Robert Henry Davis, London, England.

1,213 170. METHOD AND APPARATUS FOR LIFTING WATER. Levi T. Edwards, Philadelphia, Pa.

1. In an apparatus for lifting water, the combination of a well, a delivery pipe extending into said well, a foot piece secured to said pipe and having a flaring unobstructed inlet end submerged in the body of water, a nozzle located below said foot-piece and arranged to discharge air under pressure into said foot piece and means to supply compressed air to said nozzle.

1,213,245. CEREAL-MACHINE. David C. Parks, near Kimmswick, Mo.

1. A machine for reducing cereals to a meal like form, comprising a closed hollow cylindrical container having a central bearing in its top, a shaft mounted in said bearing and adapted to reciprocate therein, a series of cutting knives carried at the lower end of said shaft, and means for admitting compressed air to the interior of said container.

1,213,277. POWDER-LOADING DEVICE. William T. Scott, San Diego county, Cal.

1. In a device for loading explosive powder the combination of a powder receptacle provided with an aperture therein, an air inlet pipe adapted to connect with a compressed air tank and extending inwardly through the wall of said receptacle, its extended end extending to near said aperture in said receptacle and adapted to be moved to different positions relatively to said aperture for adjustment for different sized grains of powder and means for conducting the powder from said aperture to the pocket in which it is to be deposited.

1,213,302. APPARATUS FOR PRODUCING ARTIFICIAL RESPIRATION. William E. Tullar, Chicago, Ill.

1,213,342. MILK AERATOR. Michael Duvall, Marshfield, Wis.

1,213,363. AIR-BRAKE ATTACHMENT. Murray Henry, Alexandria, La.

1,213,457. PNEUMATIC BRAKE FOR AUTOMOBILES. Conway F. Candler, Orange, Cal.

1,213,522. AIR-PUMP. Charles W. Manzel, Buffalo, N. Y.

1,213,523. SHOCK-ABSORBER. Richard Martin, Alameda, Cal.

1,213,596. EVAPORATOR. William L. De Baufre, Annapolis, Md.

1. An evaporator consisting of, means of containing a solution, means of compressing the vapor from said solution consisting of a vapor actuated compressor, means of heating said solution by said compressed vapor and the exhaust from said compressor and means of drying said vapor before being compressed.

1,213,701. VACUUM MASSAGE DEVICE. Alvin L. Smith, Washington, D. C.

1,213,707. PNEUMATIC PUMP. John M. Swanstrom, Chicago, Ill.

1. In a device for raising water by compressed air, a water chamber having an air inlet opening in its upper end, a valve adapted to close the air inlet opening against the air supply pressure, means operated by the air pressure within the water chamber for causing the valve to close the air inlet opening against the air supply pressure, and means independent of the valve closing means for holding the valve in closed position.

1,213,889. TURBINE PUMP OR COMPRESSOR. Franz Lawaczeck, Halle-on-the-Saale, Germany.

1,213,901. ASPIRATOR. Elbert Ball Porter, Penn Yan, N. Y.

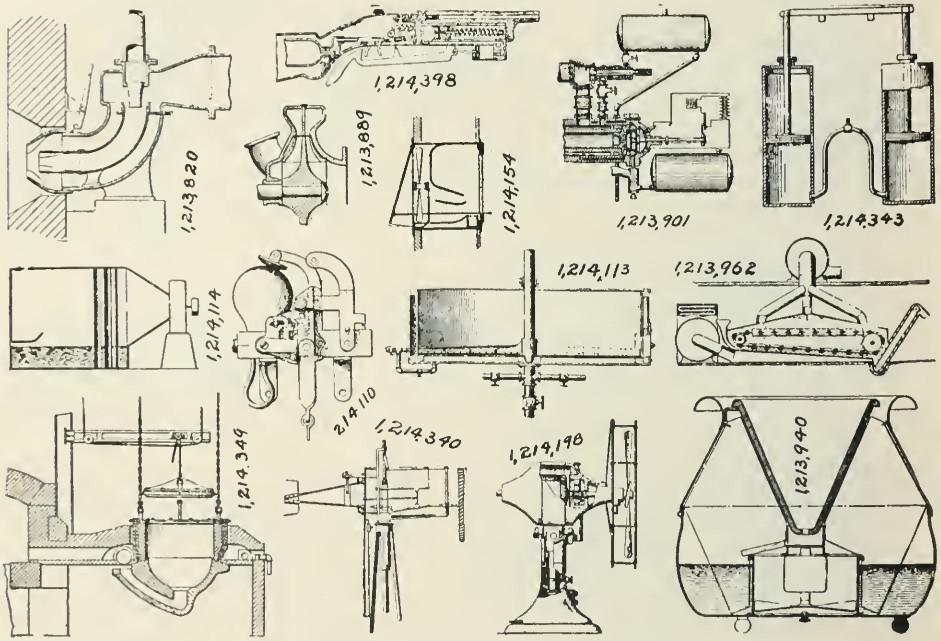
1,213,940. HUMIDIFIER. Lee H. Parker, Brookline, and Edward K. Standish, Stoughton, Mass.

1,213,962. DRYING APPARATUS. Earnest E. Siler, Chicago, Ill.

1,214,055. WELDING AND SOLDERING TORCH. Adolf Messer, Frankfort-on-the-Main, Germany.

1,214,110. MUSIC-LEAF TURNER. John B. Albert, Danbury, Conn.

1. In a leaf turner, a support, a swingingly mounted hollow leaf carrier, a self-expansible collapsible body communicatively connected with the carrier for creating a vacuum therein whereby a leaf will adhere to the carrier, and means operable in one continuous direction for effecting both a collapsing and releasing of the body.



Pneumatic Patents January 30.

1,213,710. COMBINED PRESSURE AND VACUUM RELIEF VALVE. Frederick Mortimer Timpson, Ilford, and Alexander Ogilive Robertson, London, England.

1,213,749. FIRE-EXTINGUISHER SYSTEM. Robert L. Cooney, Atlanta, Ga.

1,213,780. APPARATUS FOR COMPRESSING AIR. Stephen G. Skinner, Wilmette, Ill.

1,213,782. AIR-COOLING DEVICE. Willis H. Thomas, Portland, Oreg.

1,213,791. FLUID-PRESSURE ENGINE. James Nicolson Bailey, Stretford, England.

1,213,796. PROCESS OF COMPRESSING, PURIFYING, DRYING, AND COOLING GASES. Willard Oliver Felt, Bradford, Pa.

JANUARY 30

1,213,815. CONTROL SYSTEM FOR RAILWAY AIR-COMPRESSORS. Clinton J. Axtell, Schenectady, N. Y.

1,213,820-1-2. PULVERIZED-FUEL BURNER. Lars H. Bergman, Philadelphia, Pa.

1,214,113. TANK FOR TREATING GARBAGE. James A. Anderson, Barren Island, N. Y.

1,214,114. APPARATUS FOR CONDITIONING AIR OR OTHER GAS. Bernard R. Andrews, Newton, Mass.

1,214,154. VENTILATOR AND AIR-PURIFYING APPARATUS. Frank A. Gustavason, Seekonk, Mass.

1,214,198-9. ELECTRIC FAN. Willard M. McEwen, Chicago, Ill.

1,214,268. AIR-BAG FOR MENDING PNEUMATIC TIRES. John W. Blodgett, Chicago, Ill.

1,214,340. WINDMILL. Benjamin J. MacEwen, Canutillo, Tex.

1,214,343. SHOCK-ABSORBER. John W. Matthews, Macon, Mo.

1,214,349. WINDOW-GLASS-BLOWING APPARATUS. Tony A. Miller, Morgantown, W. Va.

1,214,398. AIR-GUN. Herman L. Welch, Los Angeles, Cal.

COMPRESSED AIR MAGAZINE
EVERYTHING PNEUMATIC

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COMPRESSED AIR IN A MODERN TANNERY

BY CHARLES C. PHELPS

One of the largest tanneries in its locality is the plant of the J. H. Ladew Co., located at Lincoln Highway and Passaic River, Newark, N. J. It specializes in the tanning of sole leather and belting butts, the capacity being 400 hides a day.

Water from the city mains is used in the various departments of the plant excepting the beam house in which the initial manufacturing process takes place. It has been found by experience that water taken from a well on the premises is much better adapted for beam house purposes than the city water, as it brings about a condition of the hide substances which puts them into better condition for the subsequent tanning processes. Judged by other standards, however, this water is of poor quality, which is probably due to the proximity of the well to the highly polluted Passaic River.

Formerly, the water was raised from this well by means of an "air lift" system for which the compressed air was supplied by a steam driven compressor. Recently, the plant has been converted extensively to electric drive and it was decided to install an electrically operated compressor to supply the air for pumping. At the same time the well piping was redesigned and the new plant was put in operation Aug. 14 of last year.

The natural flow of the well is somewhat limited, the pumping capacity being restricted to about 50 gal. a minute. There is, however, another well located about 1000 ft. distant, hence it will be a simple matter to operate the second well from the same compressor should the necessity for more water arise.

Compressed air is also used for other purposes besides pumping and it is expected that these uses will be extended in time, hence a compressor large enough to have considerable reserve capacity was purchased.

The well is lined with iron casing pipe 10 in. in diameter down to 80 ft. from the surface, this part penetrating soft ground. From the 80-ft. level down 320 ft. farther, the well has been drilled 8 in. in diameter through solid rock and left uncased. The discharge pipe extends into the well a distance of 317 ft. from the ground level. It is 3¼ in., inside diameter, for a distance of 160 ft. from the bottom. Here it is joined by swedged nipple to piping, 2¾ in. inside diameter, which extends 157 ft. to the surface. The latter piping extends a further distance of 20 ft. above the ground level, at which height the water is discharged into a tank. The latter is 16 ft. in height by 16 ft. in diameter.

As the column of aerated water ascends, the bubbles of air expand due to diminishing pressure. It is, therefore, in the upper part of the discharge pipe that slippage losses are greatest, not only due to the expansion of the air but also due to the coalescence of the bubbles. By reducing the size of the pipe toward the upper end, the discharge velocity is increased, preventing too rapid expansion and coalescence of the air bubbles and further reducing slippage losses by a quicker discharge, the slippage being more or less proportional to the time of discharge. The gain due to this cause more than offsets the greater pipe friction loss in the smaller pipe, increasing the overall efficiency.

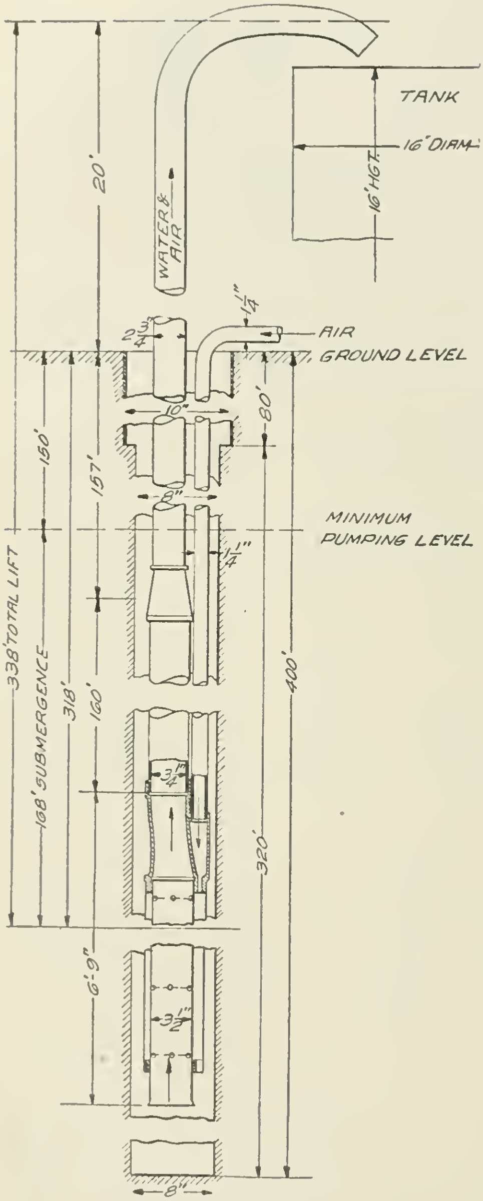

FIG. 1.

Connected to the bottom of the discharge pipe is a foot piece which is known as a Size 5 "Imperial" Class "VA" air lift pump. This increases the discharge length slightly, so that the approximate length of the discharge pipe from the point of air entrance to the tank inlet is 338 ft. The air pipe, which is 1¼ in. inside diameter, is run down the well outside of the water discharge pipe, connecting with the foot piece. These various connections are shown in Fig. 1,

Figure 1 also shows the details of the foot piece. It consists of an outer shell or casing with an inside tube of brass, the latter having a series of rings of small holes drilled as indicated. These rings of holes are spaced in such a way as to create sufficient back pressure in the foot piece to prevent slippage losses and to regulate the admission of air to the rising column of water. The water rises between the casing and inner tube covering a certain number of the perforations, and permitting the air to pass through the perforations above. The air pressure is initially regulated by the throttle so that air will pass through a sufficient number of perforations to give maximum efficiency. Furthermore, the fine openings divide the air into very fine streams giving a highly effervescent effect to the water, which is the most efficient manner of operating an air lift. Scale, dirt, etc., that might enter the foot piece from the piping, cannot clog the perforations as foreign substances are free to pass through the unobstructed openings between the outside casing and the inner tube.

The normal water level when not pumping is practically the same as that of the adjacent Passaic River, that is a few feet below the ground level, but, when pumping the water level falls rapidly until it is maintained at about 125 to 150 ft. below the surface. At the lower pumping level, the running submergence is 318 ft.—150 ft. = 168 ft., and the ratio of submergence to total lift (percentage of submergence) is 168÷338×100=50 per cent. approximately. An air pressure of about 125 lb. per sq. in. is required to start pumping, this air pressure exceeding the pressure of the head of water in the well. After the water is flowing freely, the normal air pressure carried at the head of the well is 70 lb. per sq. in.

The compressor plant is shown in operation in Fig. 2. It is an Ingersoll-Rogler, double-acting, single-stage machine of 8-in. stroke and 9-in. cylinder bore, operating at 250 r. p. m. The compressor is connected by short belt drive with a 25-hp. (nominal) alternating current General Electric motor. Figure 3

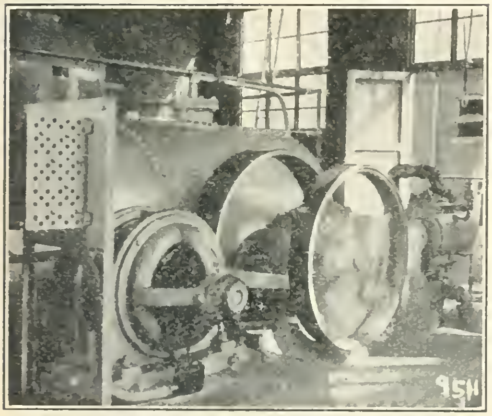

FIG. 2.

shows an end view of the compressor plant; the small pipe passing to the floor on the extreme left leads to the well.

The compressor discharges into an upright receiver 6 ft. in height by 36 in. in diameter, shown in Fig. 4. An unloader keeps the pressure in this receiver between 85 and 95 lb. pressure. When the pressure reaches the higher figure, the motor is stopped and when the pressure in the receiver falls to the lower figure the motor starts up automatically. Of course, the unloader is not allowed to act while the well is starting up at 125 lb. air pressure. The air receiver pressure is indicated on the gage adjoining the receiver on the left (Fig. 4). The pipe extending to the left conducts the air to the well. Between the two gages on the left, the air pressure is throttled down to about 70 lb. as indicated on the left gage.

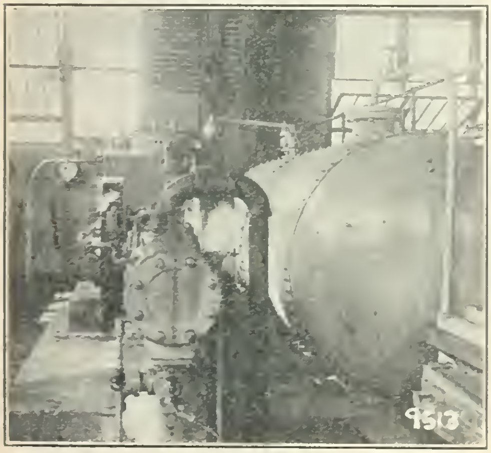

FIG. 3.

The connection below the safety valve (Fig. 4) leads to a second receiver from which air is taken for agitating purposes. This receiver, shown on the right of Fig. 3, is of horizontal type, 12 ft. long by 54 in. diameter. The problem here was to furnish a large reservoir kept full of air so that pressure might be available for agitation at any time, even though the well might be out of operation at the moment. A single large tank would require too long a period to build up sufficiently high pressure to start the air lift and, with such an arrangement, a sudden heavy demand for air for agitation might reduce the pressure so much as to render the air lift inoperative. Hence it was decided to apply a double receiver arrangement. The small receiver supplies whatever pressure is necessary for pumping and it responds quickly to the demands made upon it. The surplus air escapes to the larger receiver, gradually building up pressure in the latter.

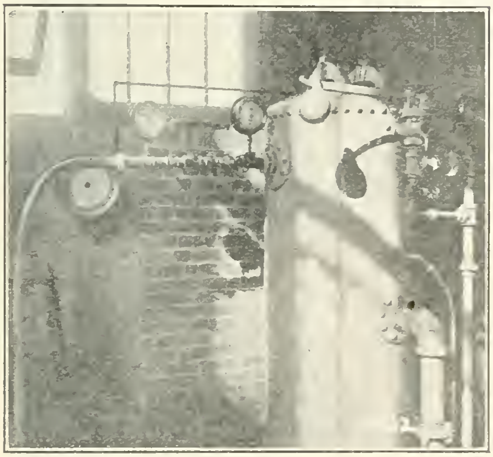

FIG. 4.

Piping connections between the two receivers are shown above to the right in Fig. 4 and more clearly in Fig. 5. A blank diaphragm with a 3-16 in. diameter aperture drilled in it is inserted between the two flanges shown here. This insures that air will not be drawn from the small tank at so rapid a rate as to interfere with the pump air supply. The air pressure in the larger receiver

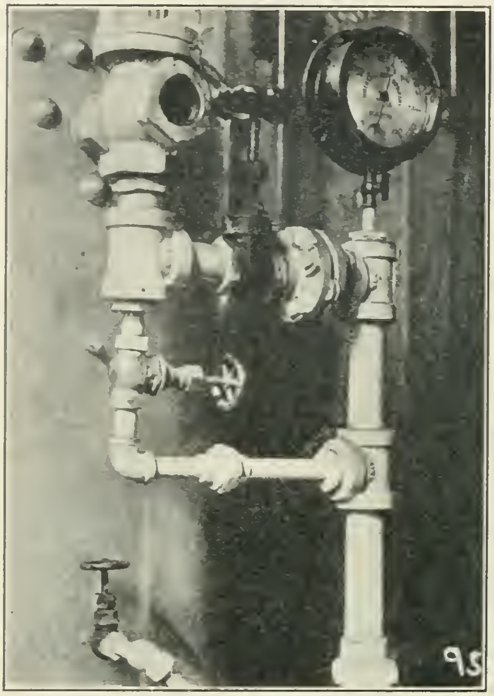

FIG. 5.

is indicated on the gage shown to the right in Fig. 4. The large valve beside the aperture may be closed when starting the air lift and whenever it is desired to cut out the large receiver. The small bypass valve permits filling the large receiver more rapidly, if desired. The plan of utilizing an aperture instead of a check valve was considered preferable because with this arrangement the large receiver acts as an equalizer after the normal working pressure is reached, lessening the service required to the starting and stopping mechanism. As the pressure tends to build up in the small tank, the large tank takes the surplus air and as it falls the aperture permits the air to return from the large tank, thus keeping the pressure range constant throughout the entire system between the limits of 85 and 95 lb. The brake horse power required at the motor to maintain this pressure is about 23 hp. The piston displacement of the compressor is 145 cu. ft. of free air per minute, which includes air used for both pumping and agitation,

Fig. 6 is a view in the beam house which contains a great number of vats embedded in the concrete floor. These vats contain the solutions in which the hides are first immersed preliminary to the removal of adhering flesh and hair. It is in connection with this department that the air lift water is employer. The procedure is to connect in a long strip perhaps 40 or 50 hides and then reel them upon the drum shown in the background of Fig. 6. The drum truck is then wheeled over one of the vats and the string of hides is unreeled into the vat. Before immersing the hides it is necessary to agitate thoroughly the solutions. For this purpose compressed air has been found to be excellently adapted. Several tubes, about 8 ft. long and ½ in. in diameter, connected with the compressed air supply by rubber hose, are used for agitating Each is capped on the end and has several perforations through which the air escapes. The tube is inserted to the bottom of the vat, the air is turned on, and in a few seconds the contents of the vat have been completely mixed. Fig. 6 shows how violently the solution is stirred, forming heavy froth on the surface. The vats in the background had not been subjected to agitation, but the one in the right foreground had been subjected to the air mixing only a few minutes before.—*Practical Engineer.*

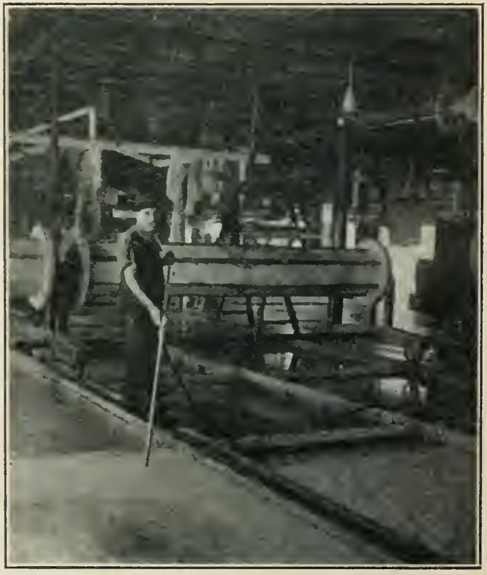

FIG. 6.

SUBAQUEOUS TUNNELING AT ITS WORST

BY CLIFFORD M. HOLLAND*

One of the four pairs of tubes now being built under the East River, New York City, in connection with the contracts for the so-called "dual" system of rapid transit subways, passes under the East River at Old Slip, Manhattan. At this point considerable difficulty was experienced in holding the compressed air in the tunnel headings, due to conditions at the face of the excavation where the shield was partly in rock and partly in earth. This earth comprised very largely filled ground containing piling and old cribbing. At the water front, furthermore, the profile of the tunnels intersected the base of the South street bulkhead wall, requiring the removal of its concrete foundation throughout the entire thickness of the wall.

The method of excavation was to drive a bottom heading of about 150 feet, into which a concrete cradle with steel rails imbedded was placed for the shield to slide on. The shield was shoved ahead on the imbedded rails 2 feet 2 inches at a time by the action of the shield jacks. Seventeen jacks were distributed around the periphery of the shield and their combined thrust, under a hydraulic pressure of 5,000 pounds per square inch, amounts to about 2,500 tons.

After each shove by the jacks one of the cast-iron rings with which the tunnel is lined was erected behind the shield inside the overlapping tail. Each ring is 2 feet 2 inches long and each consists of nine plates and a key, and is put into place by means of a hydraulic erector attached to the rear of the shield. The erector picks up each plate and pushes it into place, holding it there until it has been bolted to the last completed ring. The soft ground at the top was supported by breasting boards in order to prevent a run of material at the face of the excavation while the rock was being drilled and blasted with light charges. Progress under these conditions averaged about five feet every twenty-four hours.

In tunneling through soft ground under the river compressed air is used to drive the water out of the surrounding material and to prevent water from flowing into the tunnel, thus permitting the excavation to be done under dry conditions. The diameter of the heading on the present work is about eighteen feet, and as it is necessary to have the air pressure high enough to balance the water pressure at some point below the top of the shield there results an unbalanced pressure at the top of the tunnel due to the excess of air pressure over the water pressure at this point.

Blowouts in tunnel headings are caused by this unbalanced pressure, and in order to maintain a state of equilibrum it is necessary to have a considerable amount of material over the top of the shield as a dead weight to counterbalance this excess air pressure. Where the tunnels are under the river a thick blanket of clay is deposited in advance of the shield to serve as a cover through which the compressed air escaping from the face of the excavation cannot pass.

As long as the escape of the compressed air from the tunnel heading can be spread out around the edges of this covering blanket the danger of a blowout is largely eliminated, but if the escape of compressed air be all at one point, it is only a matter of time before it works a channel through the ground overhead and a blowout is almost certain to result.

It has been customary on this work to take daily soundings in advance of the tunnel shield in order to learn how serious the securing of the river bed due to the escape of compressed air has been during the twenty-four hours previous, and if it appear that the thickness of the river bed has been materially diminished, additional blanket is deposited from scows in order to restore the cover to the proper depth. The thickness of the clay blanket required can be computed theoretically, but the uncertainty of the condition of the bottom of the river bed is such that no great reliance can be placed upon the computations, as a single hole not located by the sounding party is liable to result in a blowout. For this reason considerably more clay blanket is placed in advance of the tunnels than is theoretically required.

In determining the safety of conditions at the face of the excavation, the amount of cover over the top of the shield is only one of several factors which have to be reckoned with, as the escaping of the compressed air at the cutting edge and tail of the shield also depends largely upon the character of the material through which the tunnel is being driven. Oftentimes a "blow" on the river surface which is violent is not a serious matter owing to the porosity of the ground permitting a free escape of the compressed air even though there is sufficient material to withstand the unbalanced air pressure, while a small, insignificant blow in compact material may give a false sense of security. The best method of meeting this situation has been to profit by experience and never permit the cover overhead to become less than a fixed minimum.

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*New York Public Service Commission.

Several delays varying from a few days to a month were caused by blowouts in the early stages of this work, two occurring while the tunnels were still under the city streets, and two where the tunnels were passing under the river bulkhead wall. Of these blowouts the most serious one occurred in the evening of December 1, 1915, preparatory to making a shove for a ring. The rock at the center of the shield directly under the breasting was shot with the men back at the tunnel bulkhead where they had retreated as was customary. Immediately after the blast the pressure in the chamber dropped from 15½ pounds to 11 pounds, and the men went into the emergency lock in the top of the tunnel preparatory to going out, as such a drop in pressure indicated that a blowout had occurred at the face of the excavation. After a few minutes, however, the tunnel, which had fogged up due to the drop in pressure, cleared as the air pressure increased again to 15 pounds, and since this indicated that the inrush of material at the face of the excavation had probably choked the blow, the men returned into the heading.

Upon investigation it was found that there was a bad blow of compressed air at the cutting edge of the shield and every effort was made to stop the blow by feeding into it bags of sawdust, empty bags, hay, or anything else that could be thrown into the opening. After about five minutes a second blow occurred and the pressure again dropped to 11 pounds. The tunnel immediately fogged up as had occurred previously, and the center of the heading blew out. This produced such a strong rush of compressed air that several of the men were nearly drawn into the hole, for at the time there were six men in front of the shield attempting to stop the leakage of compressed air. One of these men was drawn into the opening up to his shoulders and was with difficulty pulled out by the other men who clung to the shield and rock. If it had not been for the rock in advance of the shield probably the whole six men would have been lost, but this gave them a firm support in addition to the shield against which they could brace themselves and resist the outgoing compressed air. All this took place in a very few seconds and the men barely escaped before the heading filled up.

The men left the tunnel by means of the emergency lock as the water kept gaining and it was evident that nothing could be done to regain the heading from within the tunnel. The heading was regained some time later by dumping additional cover in advance of the shield from scows loaded with clay, which filled the hole in the bottom of the river so that the tunnel would hold compressed air. After waiting several weeks the air pressure was raised and after mucking out the heading the work proceeded as before the blowout.

A similar blowout under the slip at the foot of Montague Street, on the Brooklyn side, where there was a full soft ground face, resulted in three men being blown out of the shield up through the bottom of the river, only one of whom came through alive.

To meet such an emergency as a blowout, there are two provisions made for the safety of the workmen. A safety screen, extending about one-third the distance down from the top of the roof, is always kept in position to serve as a trap for the escaping compressed air. A seal is made as soon as the water reaches the bottom of the screen so all the compressed air cannot leave the tunnel. In addition there is an overhead runway suspended from the roof of the tunnel, extending from the shield under the safety screen back to the emergency lock located in the upper part of the concrete bulkhead. This lock is always kept open into the heading ready for any emergency.

In one of these blowouts a rather novel expedient was resorted to in order to reach the valve on the blow-pipe located near the shield. As the tunnels are on a down grade this valve was at the lowest point in the tunnel and, if it could be reached, by opening the valve it would be possible to blow all the water out of the tunnel heading without having to wait until additional pumps or new blow lines were installed.

One of the "sand hogs" who had had experience in diving volunteered to put on a diver's suit and go down into the heading under compressed air and open the valve. He made a successful trip down into the tunnel shield but reported that the river mud which had come in at the time of the blowout had entirely covered up the valve so that he could not reach it.

After each one of these blowouts the material in the tunnel heading was found to be a most curious mixture composed of river mud, paving blocks, brickbats, broken bottles, etc., and in one instance a live fish was found swimming around in the water.

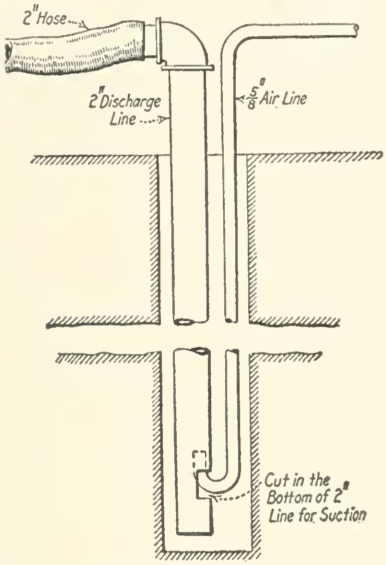
The headings of the north tube of the Old Slip-Clark Street tunnel under the East River were "holed through" on November 28, providing an early Thanksgiving celebration for the "sand hogs" and other workers, the contractors and the commission's engineers.

There have averaged 500 men working in the four headings of the Old Slip-Clark Street tunnel. At one time the digging was being carried on under 37 pounds air pressure, which was the maximum reached. The maximum allowed is only 50 pounds to the square inch. When the pressure was at its highest an average of more than a thousand men were employed daily, owing to the short shifts permitted by law for caisson workers. At this period of the work the men were employed only one and one-half hours at a stretch, entering the tunnels twice daily for an aggregate of three hours. The air pressure at the time of "holing through" had been reduced to 18 pounds and will be continuously reduced as the tunnel is caulked and made water tight, so that normal pressure will have been reached by the time the tunnel is ready for its concrete lining.

Maximum progress made on the tube just opened was 33 feet per day and the monthly maximum 343 feet. Average progress per day was 4.9 feet.

Shafts are located at Old Slip and Front Street, Manhattan, and on Furman Street at the foot of Clark Street, Brooklyn. The section has a total length of 5,900 feet, while the distance between the shafts is 3,800 feet. There is considerable shield driven tunnel work on the Brooklyn side. The contract price was $6,469,916.25.

The tunnel is 17 feet 6 inches in diameter and consists of two single track tubes. At greatest depth the bottom of the tunnel is 88 feet below the surface of the river.



AN UNDERGROUND AIR LIFT

BY THOMAS HOGARTH

The following is a description of a simple contrivance that I devised for the purpose of doing away with an underground pump. Similar devices have doubtless been used by many mining men, but at the same time there may be others who have never seen them, or perhaps have never heard of them.

The water in a mine of which I took charge was bad. The pumps and the pipes all had to be wood lined, otherwise they would only last a week or two before they were eaten out. In one place in particular the water was extremely troublesome, since it would eat the water end of the pump away in two weeks. The amount of water encountered at this point was not large, being just about sufficient to keep a 2-in. pipe flowing full. I suppose the management did not think it worth while to put in a wood-lined pump and pipes for this small quantity of water, yet it was a constant source of expense, owing to the necessity of changing the pipe and getting new pumps.

It occurred to me one day that an air lift might be employed for handling this water. I brought this device to the attention of the general superintendent, and he assured me that if the trial lift be made to work he would gladly purchase brass pipe of which to make a permanent one.

The low place in the heading where the water collected had been partly filled with dirt. I secured a 20-in. terra-cotta pipe and put it over the spot where I wanted the hole dug for the air lift. The dirt was then removed from the inside of this pipe, and in this way it was lowered into the debris. Before reaching solid rock, however, some old timber was encountered. It was necessary, therefore, to remove the terra-cotta pipe and cut away this timber, after which the pipe was lowered as before until solid rock was struck.

A 4-in. drill was then made from an old puncher pick on the end of which a 1¼-in. pipe was welded. This made a fairly good drill for the purpose. With this drill and a piece of 2-in. pipe with a bolt in the bottom used as a sludge pump, a 4-in. hole 12 ft. deep was easily put down by two men.

When this drillhole was completed I took a 2-in. pipe and about 8 in. from the bottom I cut a hole 6 in. long and half the diameter of the pipe in depth. On the upper end of the pipe I placed an elbow into which a nipple was screwed, this in turn connecting with a piece of hose. A length of 5-8 in. pipe was also secured and the end formed into a sharp return bend, this end hooking into the opening in the lower end of the 2-in. pipe. The whole was then lowered into the hole, after which the upper end of the 5-8 in. pipe was connected to an air line that had been employed for driving the pump that was formerly in use at this point.

When all was completed the air was turned on. The effect was surprising. Water was thrown all over the place. The air was consequently throttled down to about half a turn of the 5-8 in. globe valve. The device then practically threw a steady stream of water, completely filling the 2-in. pipe.

I never got the brass pipe that had been promised, but when the iron pipe eats away it does not take more than about 2 hr. to put in a new one. Of course, this is much more satisfactory and cheaper than buying and placing new water ends on the pump or furnishing new section and discharge lines.

Where compressed air is available, the method that has just been described is extremely handy for removing water from low places. I do not know, however, how it would work if the discharge line was a long one.—*Coal Age.*

[It is to be supposed that the 5-8 in. pipe above spoken of was standard ½ in. pipe, the inside diameter of which is almost exactly 5-8 in.—Ed. C. A. M.]

AIR SUPERSEDES STEAM FOR OIL BURNERS

BY C. W. HUNT, JR.

A compressed air plant with an interesting story of its own was installed about a year ago at the works of the California Brick Company, at Niles, California.

This brick company had formerly used steam for the oil burners at their kilns, but had found that the variation in pressure due to the use of steam made it necessary to use considerably more boiler power than they thought they should use, and therefore they decided to try out compressed air for the service.

They bought a 14x10 Class ER 1 compressor driven by an electric motor, the machine having been put into operation about 15 months ago, and in the first seven months of service was never shut down, day or night. It supplied air at about 35 lb. to the receiver, which meant about 30 lb. at the oil burners in the kilns.

The arrangement for this oil burning installation is a continuous line of kilns with an air pipe and an oil pipe alongside, and when a kiln is started up it is kept at full blast for four days and then allowed to cool down for three days. They have here 24 kilns used exclusively for burning pavement brick, and the service which the compressor renders has cut down the cost of burning the brick to about 25% of what it was before with the use of the boilers, as the actual power consumed is now only about 42 B. H. P. where previously they had two 100 H. P. boilers in full continuous service, with one to spare for shut-downs; and these boilers have never been fired since the compressor was installed.

San Francisco, Cal.

INTERCOOLER EFFICIENCIES

BY FRANK RICHARDS

Two stage air compression for the working pressures most commonly used, say 6 to 8 atmospheres, absolute, may be said to be now practically universal, at least where new compressors are installed, and even for pressures as low as 4 atmospheres two stage compression is well warranted and quite frequently employed. The practice has not only strong theoretical backing but also the endorsement of practical experience.

Various advantages may be cited for the arrangement: an actual reduction of power output per unit of air delivered, a more equitable distribution of load per revolution or cycle of operation, prevention of high temperatures for the working surfaces and consequently better lubrication, the elimination of moisture and the delivery of the air in better condition, both for transmission and for ultimate use.

The employment of two stage compression is entirely for the sake of the cooling of the air and the consequent reduction of volume which may be effected between the stages, and therefore the entire responsibility for the economy and practical success of two stage compression rests with the intercooler. Since the general adoption of two stage compression, under the stimulus of competitive manufacture and the constant aim to attain to approximately perfect efficiency, the intercoolers have been successively improved until at present there is little more to look for in that direction.

With perfect intercooling the temperature of the air entering the high pressure cylinder should be no higher than the intake temperature of the low pressure cylinder, but this is not attainable. Efficient intercooling is considered to be attained when the air is cooled to within 20 degrees F. of the entering cold water temperature. Compressor builders can show actual intercooler temperature reduction to within 17½ degrees of that of the cooling water with a flow of 2½ gallons per minute per 100 cu. ft. of free air, and to 14½ degrees with 4 gallons of water per minute.

The intake air temperature and the temperature of available cooling water, with the resulting compression efficiency or economy, must vary greatly with the seasons. In the winter months when temperature is low and the air is dense a compressor will deliver more air with less power input than in the hot summer months. The following are quite within the possibilities of working air temperatures in the ordinary range of the seasons:

Air Intake Temperature	Temperature of Air Entering Intercooler
70 deg. F.	254 deg. F.
32 deg. F.	175 deg. F.
0 deg. F.	145 deg. F.

The intercooler air pressure of course will not vary, as this is determined by the relative capacities of the low pressure and the high pressure cylinders, regardless of the terminal pressures.

Now it is readily seen that an intercooler could not possibly satisfy the theoretical rerequirement of delivering the air to the high pressure cylinder at the same temperature at which it enters the low pressure cylinder if the free air temperature was 20 deg. and the cooling water temperature 50 deg. Operating under such conditions would impose an overload with power input exceeding normal by about 12%. With air intake at 70 deg. and cooling water at 50 deg. it would be easily possible for a good intercooler to deliver the air to the high pressure cylinder also at 70 degrees, this constituting what might be called perfect intercooling efficiency according to the definition.

WATER JACKETING

Proper water jacketing of cylinder and heads is an important detail of compressor design, and here also there are possibilities for great differences in efficiency. Hot air is in direct and constant contact with the cylinder heads and very effective cooling may be accomplished here. It has been found that about 11% of air cooling is effected by cylinder jackets, and that the difference between a deep head jacket with proper circulation and one so shallow and so piped as to be non-effective can show a loss in air capacity of 2% and increase in horse power of 3%. Some designers have held the idea, which of course it is impossible to substantiate, that the heated film of air next to the head in the clearance space, with head not jacketed, would reduce the actual amount of air lost in the clearance, and in this manner increase the volumetric efficiency.

THE MOISTURE IN THE AIR

It is worth while to consider the question of moisture in the air as affecting power consumption and volumteric efficiency. The moisture carrying capacity of air is dependent upon and its limits are automatically determined by its pressure and its temperature, especially the latter. Pounds of water vapor in 1,000 cu. ft. of air at different temperatures and per cent. of saturation are as follows:

	25%	50%	75%	100%
100° F.	.705	1.411	2.117	2.823
70	.285	.570	.855	1.140
60	.205	.410	.615	.820
50	.145	.291	.436	.582
32	.075	.150	.226	.301

The United States Weather Bureau records for a period of 15 years show humidity as follows. We table a number of localities to show that 100% humidity seldom occurs:

	Humidity 8 A. M.	Humidity 8 p. m.
New York	76%	71%
Chicago	78	72
Denver	61	39
El Paso	53	26
Helena	66	47
Salt Lake City	59	46
Seattle	86	66
Portland	87	63
San Francisco.	87	73
Los Angeles..	78	64

For the convenience of the writer, with a specific case in mind, we may here consider the operating conditions for a compressor located at Salt Lake City, Utah.

Assumed average conditions for Salt Lake City locality:

Average humidity	50%
Elevation	5000 ft.
Atmosphere pressure	12.14 lb.
Average temperature	70°F

Intercooler pressure, when compressing to 100 lb. gage discharge pressure from high pressure cylinder, and if load is balanced, will be approximately 26 lb. or a little more than three atmospheres at 5,000 ft. elevation. When compressed to two atmospheres, the humidity of the reduced volume will then become 100%, and at three atmospheres, 117%. Then 17% of the entrained moisture or water vapor is ready to precipitate if the temperature of the air holding the moisture is sufficiently low. It will not precipitate, on account of its velocity through intercooler, unless the temperature has been reduced to considerably less than 70° F. and this is plainly impossible with cooling water at 50°F.

The temperature at which condensation or precipitation begins is the dew point or the saturation temperature for the given pressure. Air at atmospheric pressure, 70 F. and 100% humidity, will hold in suspension, in 1,000 cu. ft. volume, 1.14 lb. of water vapor, and no precipitation will occur unless the temperature is reduced or a reduction of volume by increased pressure causes a percentage of humidity above the point of saturation.

The claim has been made that the moisture can be *shocked* out of the air during its passage through the intercooler by moving it at high velocity against obstructions provided in the intercooler. Velocity in an intercooler can be considered in two ways only. It must be high enough to get maximum cooling due to the sweeping of the air over the tubes. It must be so low that appreciable drop in intercooler pressure does not occur. Intercoolers are now so designed and built that pressure drop, due to velocity, is kept down to 3½ in. to 4 in. water column, or 0.126 to 0.145 lb. per square inch.

Contrary to the shock idea, if compressed air just delivered from a compressor and carrying a load of condensed but not precipitated moisture, made excessive by the reduction of volume, could be kept in an unmoving mass, the moisture would slowly precipitate or fall to the bottom of the receiver as its temperature fell; but, as air is usually given no time to stop, only a small portion of its moisture is deposited in the receiver, and this only when the temperature has been reduced. The balance of the moisture is carried along and gradually deposited in the pipe line.

The moisture present in the air of course displaces a certain portion of the air, so that any given volume of air with all the moisture it can carry represents an actual quantity of air slightly less than the same volume of air in which the humidity was comparatively low. Some enthusiasts have greatly exaggerated this and have asserted, or as least suggested, that a standard modern compressor could be improved to the point of delivering 15% to 30% more air by the removal of the moisture in it. It is true, theoretically at least, that a little more air could be put through the compressor and delivered if the moisture were abstracted from the air *before it went into the compressor,* but the increase would be only about 1% even when the humidity was as high as 100%. Careful tests have shown that when compressing air at 50% intake humidity and when the water is cool enough to precipitate 75% of the moisture in the intercooler, there is a loss in volumetric efficiency of about ½ of 1% when correction is made for humidity and temperature.

Supposing a modern two stage compressor to be running under average conditions, the only improvement it could be expected to be made would be a reduction of horse power of about 1% for each 10 degrees that the temperature of the air leaving the compressor was lowered.

With a compressor with a 200 h. p. load, allowing $25.00 per h. p. year, and with new intercooler and separator costing $500.00, it would take ten years to save enough to pay the cost of it, with no other saving whatever.

For the data and most of the arrangement of this article I am indebted to Mr. Jos. B. Mossman, of Salt Lake City, Utah.

LUBRICATION OF ROCK DRILLS

BY CHARLES C. PHELPS

Rock drills are generally regarded as the most "rough and ready" tools in use. They can withstand almost any abuse. As a consequence many drill runners believe that any oil is good enough for lubricating a drill. While it is true that drills will run with almost any kind of oil, it is beyond question that the best results and the least repair costs are obtained only by employing lubricants especially suited to the service. For steam-operated drills a good quality heavy-body steam cylinder oil is generally found to be most suitable. For air-operated drills, the usual advice is to employ a light or medium-body oil of good quality; however, recent experiments have shown that liquid grease is much better suited for air-operated drills under many conditions of service. This lubricant has been used successfully with both hammer and piston drills, mounted and unmounted types. Liquid grease is particularly valuable for water machines, like the Leyner-Ingersoll, water jackhamer and water stopehamer, for the reason that it is not washed out by the water as readily as oil is.

Liquid grease is a substance that has the appearance of oil and flows similarly, but otherwise has the characteristics and properties of grease. It may be handled in an ordinary oil can and will flow freely through the automatic lubricators on drills. It is made by several of the oil companies. It would be impractical to list here all the various brands which are suitable for air-operated drills, but Texaco transmission grease No. 2, Polarine liquid grease, Keystone liquid grease No. 5 and No. 6 have been found to give satisfactory results.

The method of feeding is fully as important as the kind of lubricant used. Insufficient lubrication results in slower drilling speed, power wasted in friction, and a more rapid wearing out of parts with consequent higher repair expense. Lubricating too liberally simply increases the oil bill without making any appreciable gain in the operation of the drill. Too often, the matter of lubrication is left to the discretion of the drill runner, who either feeds the oil too liberally or forgets to replenish the supply until the drill runs dry and, by its poor performance, reminds him that it is time to relubricate. One of the best ways to determine whether a hammer drill is getting sufficient lubricant is to notice, when changing steels, whether the shank has oil on it. An operator soon learns to tell when a drill needs lubricant by the dry appearance of the steel shank.

The more modern drills are provided with means for automatic lubrication—features of the greatest practical value. Sometimes the oiling device is an integral part of the drill, and sometimes it is a separate part.

Fig. 1 shows the arrangement for oiling employed with a typical stoping drill. The oil well is in the handle used for rotating the stoper. The hollow handle A fits in a taper hole in the valve chest. In the handle is a porous plug C, beyond which is the oil cham-

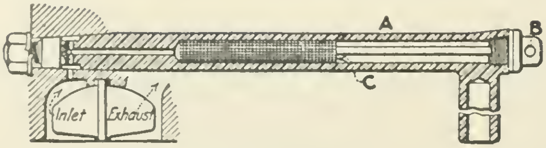


FIG. 1.

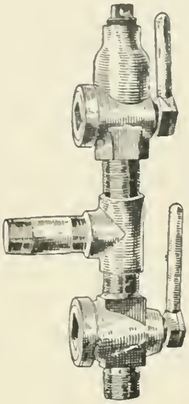


Fig. 2

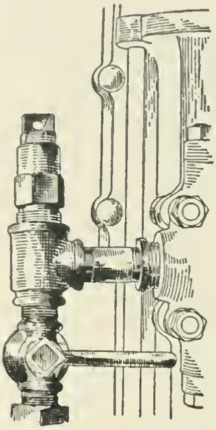


Fig. 3

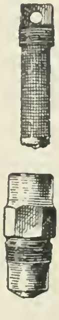


Fig. 4

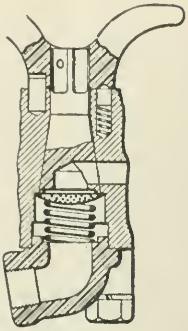


Fig. 5

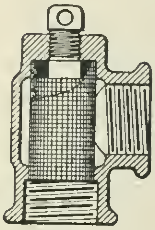
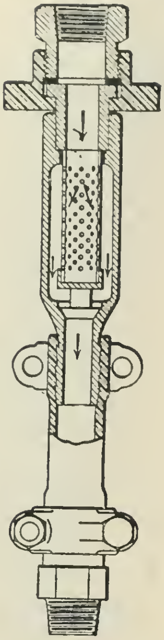


Fig. 7



ROCK DRILL LUBRICATING APPLIANCES.

ber. Before starting the machine, oil plug B is removed and the chamber in the handle filled with liquid grease. As the machine runs, the pulsations of the air in the supply chamber of the chest draw the oil through the porous plug into the machine. Means are provided to exhaust any pressure in the handle after the air is shut off without drawing the oil out of the chamber. The porous plug serves the double purpose of regulating the flow of oil and straining out any dirt or grit it may contain. A somewhat similar arrangement is used with jackhamers, but in these drills the oil chamber is placed in the side of the cylinder.

If a drill does not embody an oiling device as an integral part of its construction, it can be fitted easily with a special oiler, of which there are several types on the market. In fact, many modern drills are designed to be used with oilers of the external type.

Fig. 2 shows a satisfactory type of external oiler which embodies an oil reservoir of about a half-pint capacity. It is made of malleable iron with a taper plug valve, and is intended for use with either air- or steam-operated piston drills. The reservoir is closed with a screw plug. The taper plug has two cups on opposite sides, each holding about a teaspoonful of oil. One cup is always in communication with the reservoir and filled. A half-turn of the handle empties this cup into the supply passage to the drill, and the oil is carried as a spray into the machine. The other cup is filled ready for another turn of the handle. The reservoir holds enough oil for a half-shift's run, and the handle should be thrown about every 5 to 10 ft. of drilling. The right amount of oil is admitted each time, with no loss of oil or pressure.

Another type of oiler, Fig. 3, is designed to take the responsibility for proper drill lubrication out of the hands of the runner and place it entirely in those of the foreman. It operates by the pulsations of air in the supply pipe near the drill, due to the alternating reversals of the drill piston, and from the nature of its operation has been aptly named the "Heart Beat" oiler. It consists of an oiler body containing a plug carrying a cartridge of wire gauze and an absorbent material (Fig. 4). The body is screwed into a tee, to the branch of which the drill is connected, the oiler coming above the tee and the throttle.

The cartridges are carried in boxes. Three cartridges will suffice for one shift. The drill runner going on shift gets three cartridges from the foreman, and coming off shift, he returns three dry cartridges, which are dropped in a tub of oil and recharged. There is no way of drying the cartridges except by using them in the drill, and the return of dry cartridges is proof the drill has been properly oiled. The oil is not wasted—blown out without doing useful work—but is fed slowly and used to best advantage.

The "Heart Beat" oiler not only enforces proper lubrication of the drill, thus reducing its wear and increasing its capacity, but also economizes lubricant. This type of oiler is intended only for use with air-operated piston drills.

Sometimes drill runners introduce oil through the hose, pouring it in before connecting the drill line to the pressure main, thereby saving themselves the trouble of unscrewing the oil plugs of the drill. This practice cannot be condemned too emphatically, for the oil rapidly destroys the rubber lining used in ordinary hose, and furthermore, it carries into the drill any particles of dirt that may have lodged in the hose.

The remaining important point to be considered in connection with lubrication pertains to grit, dirt and other foreign matter. It is scarcely necessary to mention that the working parts of the drill should be cleaned frequently, preferably with kerosene, and kept well oiled or greased while standing idle.

Dirt must be prevented from entering the drill either with the lubricant or with the compressed air. The former point is taken care of by using a good quality of liquid grease only or oil free from impurities and keeping the supply in a closed vessel. A little grit will do a lot of damage in cutting out cylinders, valves and rotation parts. Small particles of grit and dust pass through the hose, and these must be removed before entering the drill, usually, by an air strainer or filter of some type placed as close to the drill inlet as practicable.

Fig. 5 shows the details of a strainer placed within a stoping drill. This strainer consists of a cup-shaped disk of perforated metal held in position back of the throttle valve by a coiled spring. It has been objected by some that a strainer such as this will result in loss of air pressure. However, tests at various pressures have shown that no reduction in air consumption or loss of power occurs through its use. If the work done by the machine falls off, it is an indication that the strainer is clogged with dirt and needs cleaning. It will be noticed that the air inlet is enlarged at the strainer, permitting an unrestricted flow of air.

Fig. 6 shows another type of strainer, which is principally intended for use on stope drills. The straining medium consists of a piece of perforated metal rolled into the form of a tube. The connection of which this type of strainer is a part should always remain attached to the valve chest when the machine is disconnected from the pressure line to prevent dust from entering the tool while lying idle. Dirt collects on the inside of the straining tube and may be easily removed from time to time by taking the device off the drill and blowing air through it from the end opposite that into which air ordinarily enters. Fig. 7 shows a sectional view of an angle filter, which forms a part of the standard equipment of certain water drills.

The straining medium in the filter, illustrated in Fig. 7 consists of a tube of brass wire cloth through which the air must pass to enter the machine. The area through this tube is greatly in excess of the area of the inlet and outlet passages, which insures a free flow of air.—*Eng. and Min. Journal.*

COMPRESSED AIR AS A COOLANT IN METAL CUTTING

In milling cast iron and similar operations where the production of short chips makes lubrication of the bearing between the chip and lip of the tool a matter of minor importance, satisfactory results may often be obtained by the use of compressed air delivered to the tool and work in such a way that it absorbs the heat generated by the cut. An advantage of the use of compressed air is that there is absolutely no tendency to gum, and the work is clean and dry when it leaves the machines; also, absence of moisture does away with all danger of rusting the work or machine parts. Fig. 1 shows the method of applying compressed air in milling a typewriter part in the plant of the Royal Typewriter Co., Hartford, Conn. This bar has a slot 7-32 inch wide by 13-32 inch deep milled for its entire length, which is 8¾ inches. The compressed air is delivered through an air line arranged in such a way as to decrease the pressure at the machine to one pound per square inch. At each side of the milling cutters there are pipes A bent to the same radius as the cutters; a number of holes are drilled in these pipes, so that air impinges directly upon the milling-cutter teeth. The pressure of the air is not sufficient to cause the chips to be blown around, but the air absorbs heat from the cutters and work, preventing overheating and excessive wear. The slot is finished at a single cut by milling cutters 2¾ inches in diameter which run at 120 revolutions per minute. One piece is finished in one minute, twelve seconds. When finished the work is sufficiently cool so that it can be picked up and held in the hand.

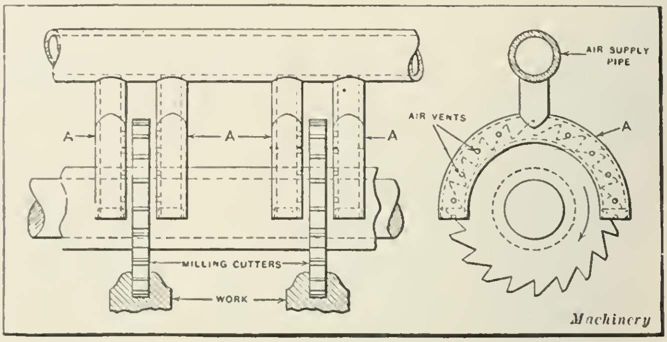


FIG. I.

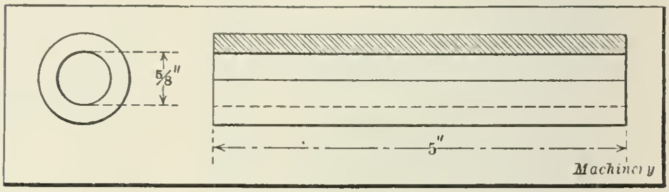


FIG. 2.

Fig. 2 shows another example of the application of compressed air for cooling cutting tools. In this case the operation is performed on a Cleveland automatic. The work is a 0.20 to 0.30 per cent carbon machine-steel piston-pin; this is of particular interest because although it is known that compressed air can be used in drilling cast iron with satisfactory results, few mechanics would expect to be able to use it in deep-hole drilling operations in machine steel. The automatic screw machine is fitted up with the regular oil-feed mechanism for the turret tools, but instead of forcing the oil through the piping, compressed air is delivered at a pressure of 75 pounds per square inch. The drill is a regular high-speed steel oil-tube type, with cutting edges ground to break up the chips so that they may be readily removed. So efficient is the compressed air that it is found unnecessary to withdraw the tool until the piece has been completely drilled to a depth of 5 inches, using a feed of 0.015 inch per revolution and a surface speed of 70 feet per minute. This speed is lower than a high speed steel drill will stand, but it has been found that a heavy feed with a lower speed gives the best results, as it produces chips which may be easily blown out. The chips are quite cool when they leave the hole and an excellent finish is produced. Before adopting compressed air, lard oil was used for this job, but this proved unsatisfactory due to heating and binding of the drill before the lubricant had reached the bottom of the hole. Apparently the oil made the chips adhere to one another and prevented them from being washed out freely, while with the air the chips are kept clean and cool and are blown out as rapidly as they are produced. This method is used at the plant of the Dayton Motor Car Company, Dayton, Ohio.—*Edward K. Hammond in Machinery.*

COMPRESSOR UNLOADER SAVES POWER

BY C. W. HUNT, JR.

An installation which should be of interest to readers of Compressed Air Magazine is that of a 15 and 9x12 Imperial Type XB2 compressor installed at the mine of the Round Mountain Mining Company, Round Mountain, Nevada.

This machine has been in use about four years, and was at first equipped only with an inlet loader of the Imperial type. Another compressor having been purchased with a discharge line unloader it was suggested that a discharge line unloader should be applied also to this machine. For three or four months the management objected that they did not want to go to the additional expense of $60.00. They, however, finally decided to instal the discharge line unloader in conjunction with their inlet unloader, and in the first month's operation the actual saving was $15.20.

The next month they ran one shift of 10 hours each day for 28 days in the month, and the saving in their power bill was figured out by them to be slightly over $28.00 for the month, this due entirely to the use of the discharge line unloader. If there is a better instance of money saving by a small investment in an improved appliance I do not know of it.

San Francisco, Cal.

AIR AND HEAT FOR DRYING

BY GILBERT C. SHODWELL*

Drying is not accomplished directly by heat nor by air alone, but air is a common and convenient medium which if properly applied is capable of absorbing and conveying moisture. Air will, as we may say, dissolve water in practically the same way that water will dissolve any such substance as sugar or salt. Water at any temperature will take up only a certain amount of sugar or other solid solution. Beyond a certain point (termed the saturation point) no more sugar can be dissolved by the water if the temperature remain the same. In order to absorb more sugar or salt in the same volume of water, the temperature of the water must be raised. Moreover, the process of absorption of the sugar or salt will be materially accelerated if the water be put in motion.

There are thousands of dry rooms throughout the country which have in them gas burners, steam coils, or other sources of heat, and which have no air outlet. They are, in effect, merely sweat rooms—they are exceedingly inefficient. They only accomplish results partially and even so, take a far longer time to do this partial work than is necessary.

In some cases these sweat rooms have effected a fraction of the solution of the problem by the use of fans on the ceiling or elsewhere so as to keep the air in motion and bring about a condition somewhat analogous to the stirring of the cup of coffee with sugar in it. But it is at once apparent that these fans merely churn the air, and as all the moisture is kept in the room, that this air, without being changed, cannot be of any use for drying when once it has reached the point of saturation.

It is true that there are certain operations which demand a circulation and recirculation of the same volume of air several times through a dry room before it is finally discharged into the outside atmosphere, but the large majority of drying problems are served best by blowing properly heated air into the dry room, then bringing it into intimate contact with the products to be dried, and finally allowing it to be discharged from the room.

DRYING AT LOW TEMPERATURE

All have noticed the ice which accumulates on the outside of the ammonia pipes in a refrigerating plant and are no doubt aware that this ice is formed from the water or moisture which is condensed from the air in the room, because its temperature has been reduced so much that it cannot retain all the moisture which it carried at the higher temperature; so dew forms on the pipes and is frozen. If air which was saturated at 32 deg. Fahr., has its temperature raised to 70 deg., it will be very dry, having a relative humidity of only about 18 per cent.

It is possible and perfectly feasible, and is moreover common practice, to accomplish drying at as low a temperature as 70 deg. Fahr. This is resorted to extensively, in the drying of products which will not stand a higher temperature, such as the drying of motion picture films, etc. In such cases the air is first of all "squeezed" dry of its moisture by means of refrigerating it and afterwards this dry air has its temperature raised to the required degree.

AIR IS CHEAP

As a drying medium air costs nothing; 70 cu. ft. of manufactured city gas will raise the temperature of 20,000 cu. ft. of air from 70 deg. to 170 deg. Fahr., or 10,000 cu. ft. of air from 70 deg. to 270 deg. Fahr., with an air heater to be described later. Twenty thousand cu. ft. of air at 170 deg. Fahr., if saturated, will carry away more than 25 lbs. of water; 10,000 cu. ft of air at 270 deg. Fahr., would carry away an infinite amount of moisture (because this temperature is above the boiling point of water) if the air contained sufficient heat to evaporate the water. If air with 100 per cent. humidity and at 70 deg. Fahr. be passed through this air heater so as to increase its temperature to 80 deg. Fahr., its humidity will then be reduced to less than 50 per cent. If its temperature be increased to 170 deg. Fahr., its humidity will be reduced below 0.09 per cent. This air will be very much drier than is ever found in nature and will absorb moisture very rapidly indeed.

---

*Abstract of paper before American Society of Heating and Ventilating Engineers.

A concrete example will illustrate this: If saturated air at say, 70 deg. Fahr. has its temperature increased only 10 deg., it can then absorb as much more water as it carried at 70 deg. and still have a humidity of less than 50 per cent. This is clearly seen from Fig. 1, which shows the quantity of moisture that one pound of air will contain when saturated at different temperatures. The hotter the air the more moisture it can carry. 10,000 cu. ft. of air at 270 deg. Fahr. contains sufficient heat to evaporate more than 50 lbs. of water, but in so doing it gives up some of its heat, bringing the air again below the boiling point of water. From this it is evident that to carry away this amount of moisture efficiently, about twice this quantity of air should be figured.

HEATING IS NOT DRYING

An even load of lacquered or japaned goods has but an infinitesimal fraction of soluble vapor to the total of air in the oven, so that this quantity of air is well able to take care of the vapor as a rule. The heating of products in an oven such as lacquered or japanned goods is strictly a baking proposition and although they become dry, it is not the same kind of drying as takes place when wet products are dried in a dry room. Meat, bread, etc., when placed in an oven are not dried in the proper sense of the word, although they may give up some of their moisture, but the physical and chemical compositions of such products are definitely changed and we call this change "baking." It is therefore probably a confusion between the processes of baking and drying which has led many people astray.

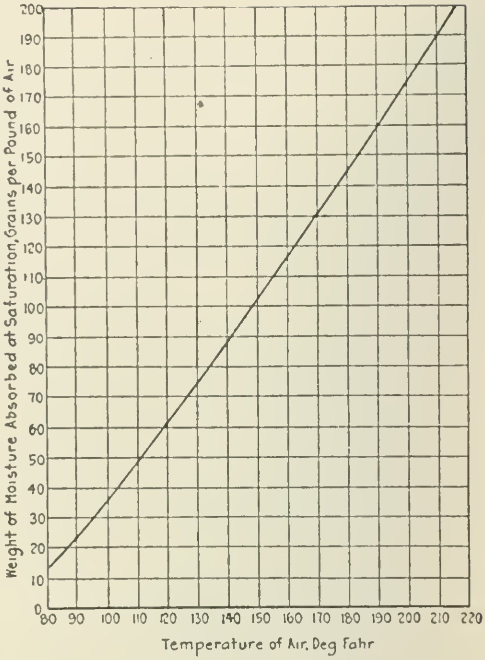


FIG. 1. MOISTURE IN ONE POUND OF AIR.

In order to use heated air for drying so that results will be entirely satisfactory it must be heated efficiently, and this has taken many years of thought and experimentation on the part of engineers. The mere heating of air by the means previously in vogue would have been a great handicap to success owing to their inefficiency, but this has been overcome by the use of a suitable heater.

Calculation of the size of heater to use on any particular installation is very simple. Experience has shown that it is desirable to change the air in the average dry-room from two to five times per minute, and the air should be supplied at the highest temperature which the material to be dried will stand. The proper temperatures for different materials are given in Table 1. When high temperatures are used for drying, that is, temperatures above 250 deg. Fahr., the oven or dry-room must be well insulated to prevent the loss of heat through its walls.

AIR CIRCULATION

Also the distribution of the heated air is important. It is necessary that the heated

TABLE 1. TEMPERATURES REQUIRED FOR DRYING DIFFERENT MATERIALS.

Drying	Temperature Required (deg. fahr.)	Drying	Temperature Required (deg. fahr.)
Treated or dyed paper	150-220	Herbs	†
Glued paper	160-300*	Barks	†
Glued tapes	160-300*	Pills	†
Pasted ribbons	160-200	Furs	150-190
Printing ink	70-300*	Size on paper	150-220
Felt Hats	140-180	Bedding	150-190
Glued Ladies' Hats	140-180	Nuts	90-140
Matches	140-180	Cereals	110-150
Macaroni	110-150	Glassware	†
Photo Prints	90-110	Hops	120-180
Photo Negatives	90-110	Rags	120-180
Photo Films	90-110	Overalls	120-180
Feathers	150-180	Bathing suits	120-180
Hair Goods	150-190	Blankets	140-180
Clothes	†	Knitted Fabrics	140-180
Drugs	†	Gut	150-200
		etc., etc., etc.	

---

*Can be dried at any temperature under 300 deg fahr., that it is convenient to use.
†Depending on nature.

air from the heater be distributed directly to the product to be dried by means of air ducts or pipes. If the air be merely blown into the dry-room, most of it will, except in rare cases, pass around the sides of the product next to the walls of the room and be wasted Great care should be used in the arrangement of the product to be dried, to see that the air will circulate through or about every particle of it; the results will repay the effort.

In calculating drying problems, if greater accuracy be required, Table 2 may be employed. Column A of the table shows the air temperatures leaving the heater to enter the dry-room; columns B and D give the greatest possible amount of moisture which can be absorbed at each temperature; columns C and F show how much air, when saturated, will take up one lb. of water.

A PRACTICAL PROBLEM IN DRYING

Suppose blankets are to be dried, that when dry, they weigh 100 lb., and when wet, 200 lb.: the amount of water to be evap-

TABLE 2. MOISTURE REMOVING CAPACITY OF AIR

	Entering Heater Saturated. at 70 deg. fahr.		Entering Half-Saturated. (50% Relative Humidity) at 70 deg. fahr.	
A Temp. of Air entering Dry-room deg. fahr.	B Water-carrying capacity of air Grains per lb. of air	C Cu. ft. of air (at saturation) required per lb. of water vapor	D Water-carrying capacity of air Grains per lb. of air	E Cu. ft. of air (at saturation) required per lb. of water vapor
80	11.6	8240	28.6	3300
90	23.9	4050	39.7	2380
100	36.3	2640	51.2	1845
110	48.8	1965	62.5	1515
120	61.8	1525	74.5	1270
130	74.8	1280	87.0	1085
140	87.8	1090	99.5	950
150	101.8	934	112.0	845
160	116.3	827	125.0	755
170	130.8	732	138.0	685
180	145.3	662	151.0	625
190	159.8	600	164.5	575
200	174.3	562	178.5	530

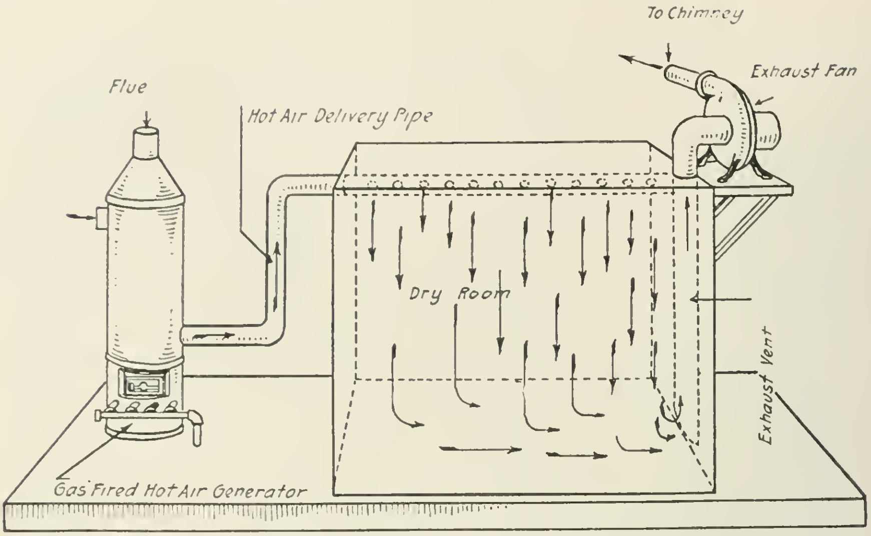


FIG. 2. DRYING BY BLOWING AIR.

orated will then be 100 lb. Assume the dry-room to be 7 by 5 by 10 ft., or 350 cu. ft., that the air enters it at 140 deg. fahr., and the number of cubic feet of heated air per hour at that temperature to be 38,500 with a small heater. We find from column C, Table 2, that 1,090 cu. ft. of air are required per pound of water. Thus for 100 lb. of water, 109,000 cu. ft. would be required. Hence the time taken, theoretically, to dry the blankets would be $\frac{109000}{38500}$ hours, or about 170 minutes, if the "used" air be saturated. In practice, the air will not become saturated so this time should be doubled. A large heater, which has double the capacity of the small, will do the same work in half the time or twice the work in the same time. It is interesting to note that this method of calculation checks up with the first method. Thus: 109,000 cu. ft. in 170 minutes, is equal to about 650 cu. ft. per minute. The heater has a capacity of about 650 cu. ft. per minute. The dry-room has a volume of 350 cu. ft., which thus allows about two changes of air per minute; or, with the great-

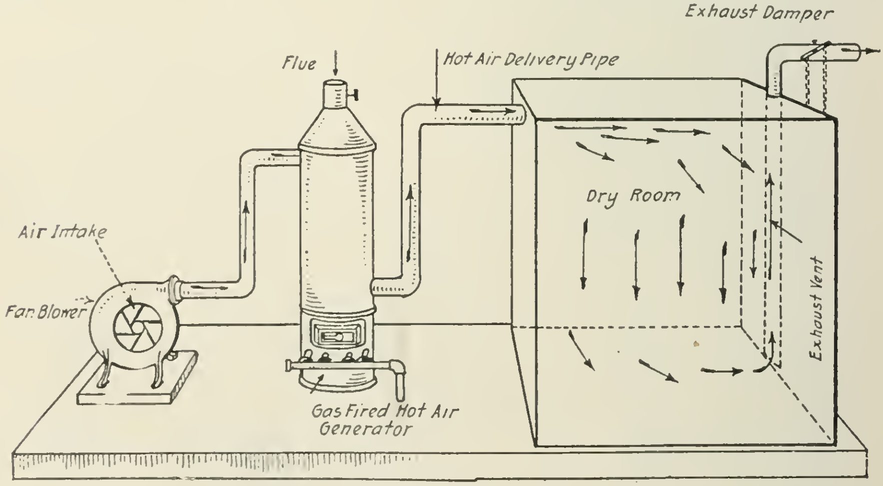


FIG. 3. DRYING BY EXHAUSTING AIR.

er allowance advised as a "factor of safety" and if the air were doubled, there would be 3½ to 4 changes of air per minute, which checks with the estimate of 2 to 5 changes per minute previously made.

To calculate the volume of air at any gas consumption other than the maximum, the following formula may be used:

$$C = \frac{E}{A_2} \times B \times G \times K.$$

Where C=Capacity in column F;
E=Value shown in column E;
A_2=Value shown in column A_2;
B=B.t.u. per cu. ft. of gas;
G=Gas consumption in cu. ft. per hr.;
K=A constant depending on the efficiency which is high at low temperatures and gradually falls from 90 per cent. at 80 deg. Fahr. to 75 per cent. at 300 deg. Fahr. 80 per cent. is a fair average. Therefore, use K as 0.8.

EFFICIENCY OF HEATED AIR

Heated air in motion is the cheapest and most efficient drying medium; it will absorb any kind of moisture, vapors, or gases. The effect of the weather on this method is negligible; it can be used all day and every day. Cold, natural air, even on a fine day, takes from six to thirty times as long as air supplied this way; it will accomplish in a day what would take a week by ordinary drying methods. Most important is the absolute temperature control easily maintained with this system of drying. From Table 2 it is evident that the drying temperature may vary considerably for the same substance.

It is possible to deliver the heated air so that it may be used for drying products in the dry room which will materially affect the rate of drying. For instance, if blankets or other goods be placed in a heap on the floor, so that air cannot reach the innermost parts, their drying may be a matter of hours instead of minutes.

Figs. 2 and 3 give a diagrammatic representation of the methods of connecting an air heater with a drying room, first, by blowing the air through, and second, by exhausting it.

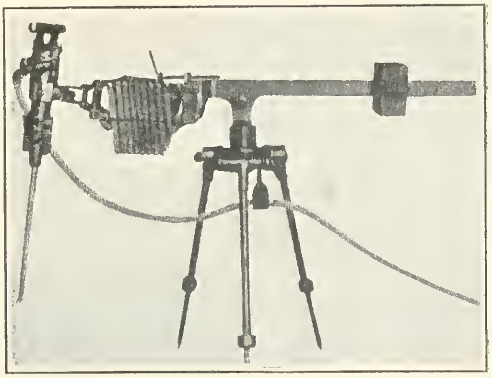


FIG. 1.

COUNTERBALANCED HAMMER DRILL HOLDER

The two little half tones on this page tell quite clearly the story of a novel drill mounting recently put on the market by the Jackson, Schmitz & Shanks Engineering Company, Chicago. The holder is designed to hold any of the standard pneumatic tools weighing from 20 to 150 lb. It is quickly adjusted by the workmen to suit a wide variety of conditions, and when the arm is fully extended as in Fig. 2, there is an operating range of 16 ft. without shifting.

The device is shown here as of general interest to our readers and for whatever it may be worth in practice. It can scarcely fail to be noticed that with it in use the hammer drill ceases to be an instantly portable one-man tool, although there might be conditions which would favor its employment.

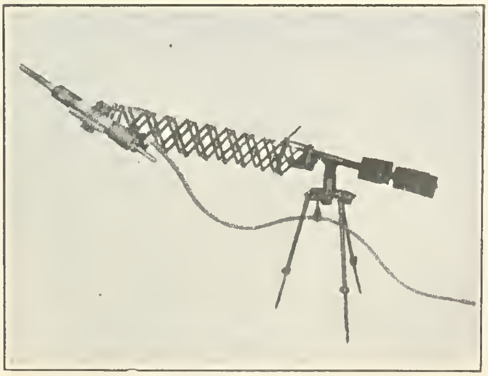


FIG. 2.

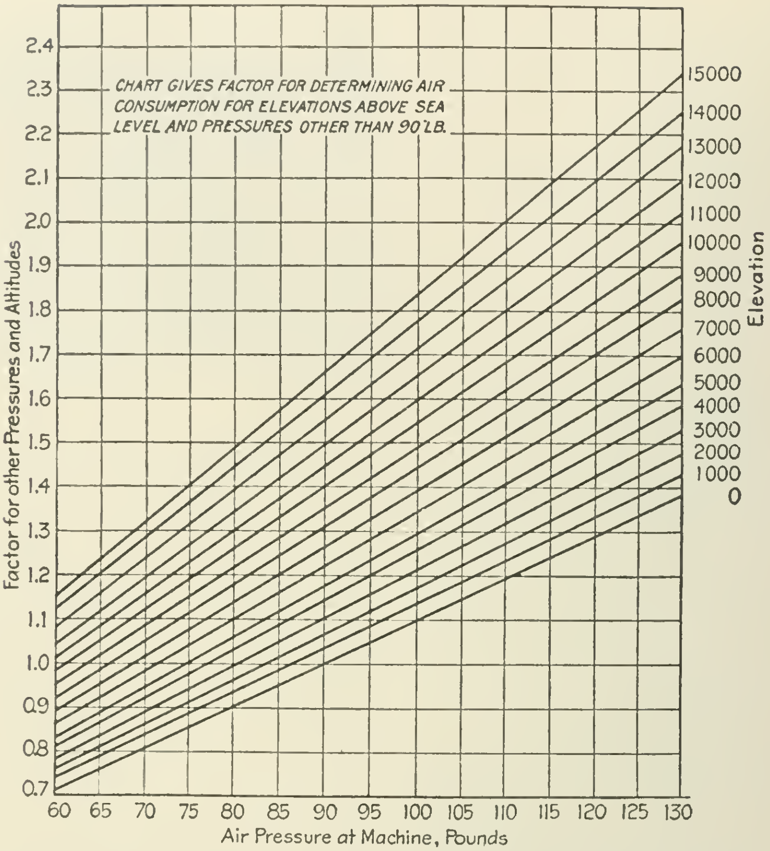


CHART FOR FINDING FACTORS FOR AIR CONSUMPTION OF DRILLS

CHART FOR FINDING AIR CONSUMPTION OF DRILLS

BY ROBERT S. LEWIS*

The accompanying chart is a modification of the one appearing in "Rock Drilling," by Dana and Saunders, with the addition of data for hammer drills and basing the diagram on an air pressure of 90 lb. per sq. in. at the drill instead of 75 lb., to conform more nearly with the requirements of modern practice.

The inclined lines are based on a sea-level datum and 90 lb. pressure per sq. in. at the drill. This gives a factor of 1; for any other altitude or pressure at drill, the factor is found at the left margin, passing there from the intersection of the inclined line of the given altitude with a vertical through the given pressure.

The average consumption of air for both piston and hammer drills is given in Table 1. Hammer drills vary so in air consumption that only general figures can be given. Catalogs from drill manufacturers will give the consumption for any particular drill, and generally at 90 lb. pressure and at sea level. By means of the chart the consumption for other conditions can be quickly found.

In case more than one drill is used, the factor by which to multiply the air consumption of one drill to determine the consumption of a number is to be taken from Table 2. This is based on manufacturers' statements. When a number are working, they are seldom all running at the same time. This table covers the requirements from one to sixty drills.—*Eng. and Min. Journal.*

---

*Associate professor of mining, University of Utah, Salt Lake City, Utah.

TABLE 1. AIR CONSUMPTION OF ROCK DRILLS, CU.FT. PER MIN.

90 Lb. at Sea Level. Piston Drills

Drills, in. . .	2	2¼	2½	2⅝	2¾	3	3⅛	3¼	3⅝	4¼	5
Cu.ft.	68	87	92	98	118	125	129	136	161	210	250

90 Lb. at Sea Level. Hammer Drills

Stopers	Drifters	Sinkers	Block Holing	Hitch Cutters
48–55–58	40–60	38–60	25–30	15–25

TABLE 2. AIR CONSUMPTION FOR MORE THAN ONE DRILL

No. of Drills. . .	1	2	3	4	5	6	7	8	9	10
Factor.	1.0	1.8	2.7	3.4	4.1	4.8	5.5	6.1	6.7	7.3
No. of Drills. . .	11	12	15	20	25	30	35	40	50	60
Factor.	7.8	8.4	10.3	12.8	15.1	17.3	19.7	22.0	26.5	30.5

MINE UNWATERING WITH AIR LIFT

BY S. H. BROCKUNLER

The unwatering of the Herman mine at Westville, Calif., recently accomplished, presented some unusual features. The large pump had been submerged through the carelessness of a foreman, and the small pumps, while efficient, were not capable of handling the water rapidly. It was therefore decided to try air lifts.

The shaft was inclined at an angle of 52 deg., and was 400 ft. deep. When the mine was closed down, three years before, 256 ft. of 4-in. air column was left in the shaft, with the expectation of using it for air to run the pumps and drills at a higher level. The lower end was therefore closed, but water leaked in and the column was found full.

It was decided to use this air pipe for the lift, but before doing so it was necessary to shoot the lower end off and this involved several nice problems. The length of the column was first carefully measured by weighting a steel tape and lowering it within the column. It was then calculated where a shot should be placed to come midway between the wall plates of the shaft, near the bottom of the pipe, so that it would not disturb the timbers.

The cartridge was prepared by binding four sticks of 40% dynamite tightly together, priming it with two electric detonators, attaching their terminals to No. 18 insulated copper wire, carefully binding the connections with water-proof tape and daubing the latter with pitch. In order to use the insulated wire for lowering the cartridge, as well as for firing it, a half-hitch was made with the wires around the cartridge, securing them firmly, so that there would be no pull on the detonators. The cartridge was weighted by attaching to it a piece of 1-in. pipe cut to such a length that it would support the cartridge at the place, above the bottom of the column, where it was desired the explosion should occur.

The preliminary tests were made with the insulated wire and detonators by firing a pair of detonators under water, after a submergence of half an hour, when it was found that it took six ordinary dry cells connected in series to get good results. When everything was ready, the cartridge was lowered nearly to the bottom of the column before meeting an obstruction—a tee, as was afterward found. If it had not been for the pipe weight, the work would have been held up at that point, but by gently raising and lowering the cartridge, the pipe finally guided it by the obstruction and landed firmly on the bottom, as was shown by a mark previously measured off on the conducting wires. Several hundred feet more wire was then run off and connected to one terminal of the batteries; it was then a simple thing to fire the cartridge by touching the other terminal of the batteries to the remaining conducting wire. Subsequent unwatering showed that the column had been cut cleanly at the exact point desired.

The factors for the air lift were now: 5000 ft. elevation, compressor capacity 1250 cu. ft. free air per minute compressed to 100 lb., 253 ft. of 4-in. pipe in shaft at slope of 52° giving a vertical head of 199 ft. From these data it was decided that a 1½-in. air pipe within the column would furnish sufficient air to lower the water to the second level, at 164 ft., starting with a submergence of 100% and stopping with a submergence of 33%. As a matter of fact the air lift began to balk at 40% submergence, and failed to unwater as far as the station by 20 ft., thus necessitating the lowering of the air lift to reach it.

A pump head was made by grinding down a 1½-in. return elbow until it would slide inside the 4-in. pipe. To one side of this was screwed the 1½-in. air pipe and to the other side a 1½-in. nipple 9 in. long. On the upper end of this nipple was screwed a cap perforated with 3-16 in. holes, to act as the air vent for the lift. This pump head, with air pipe attached, was then lowered inside the 4-in. pipe to near its bottom, and the air turned on, with the usual result of inexperience—too much air used, resulting in shower baths for onlookers. However, the flow of air was soon regulated and the water flow for several weeks, night and day, averaged 180 gal. per min., as measured over a dam. Subsequently, two additional lifts were put in, consisting of 2-in. pipe with side inlets, of 1-in. pipe with ¾-in. nozzles. These delivered 40 gal. per min. each. All failed below 40% submergence.

The consumption of air and power to operate these lifts was much higher than the theoretical figures, but this is partly explained by a break that was found in the large water column after unwatering. After reaching a depth of 164 ft. the remainder of the unwatering had to be done by pumps. This was much slower, even with the smaller amount of water contained in the lower workings.

It is uncertain whether the shot caused the break in the column, two lengths above the location of the shot, or whether it was there before. The air could be heard bubbling up, but the trouble could not be located. If anyone should repeat this experience and hear air bubbling or boiling in the mine, our advice is to first locate the break by raising and then lowering the air pipe within the column and listening to the sound. If the break is too far up, it will be best to bandon the fixed column if possible and lower another. This would be rather a difficult job in an inclined shaft full of wreckage of stulls and timbers, but by careful manipulation and using a large wooden cone attached to the lower end of the column, it might be accomplished.

It was expected to submit careful tests of power and air consumed, but the break of the main column rendered these useless for comparison with normal working conditions. But even with these unfavorable circumstances six weeks' time was saved and the cost was $1,330 less than it would have been had the pumps available been used—judging by their expense and rate of work when they were used after abandoning the air lifts.—*Eng. and Min. Journal.*

PREVENTING WEEDS ON RAILROAD TRACKS

The following is furnished by a correspondent as supplementary to a question and answer on the above topic which appeared in a recent issue of *The Sun*, New York. You say, he says, that you have not heard of anything being used specifically to keep grass and weeds from sprouting in and along railroad tracks. Our latest equipment for this purpose used in our steam railroad work is capable of treating over a hundred miles of track a day. The makeup of the train is six tank cars, engine and box car, and a flat car in front. In the tank car immediately back of the flat car we carry a concentrated chemical. We pump an equal amount of concentrated chemical from this car to each of the other four tank cars, filling each car with water and then agitating the mixture by perforated pipes inside of each car and attached to an auxiliary air compressor on the engine. The flat car is equipped with a large gasolene motor connected to a centrifugal pump, which is used to pump the solution forward from the four mixing cars and sprayed out from perforated pipes. The pipes are sectional and are controlled by levers, enabling the application superintendent to sprinkle only between the rails, to the tie ends on one side or beyond the tie ends to the shoulder on one side, or entirely across from shoulder to shoulder, according to the vegetation and the way it is distributed.

Our method of track weeding has been used by over fifty railroads and traction companies all over the country for the past five years. Last year we treated over 3,500 miles of track for such roads as the Southern Railway, Seaboard Air Line, Chicago and Northwestern, Rock Island Lines, Toledo and Ohio Central (New York Central Lines), Oregon, Washington Railroad and Navigation Company, Sunset Central, Erie Railroad and the Pennsylvania Railroad, besides a great number of electric railways.

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THE HUMIDITY PROBLEM

It is much to be regretted that we have not an instrument as handy and as readily readable as the thermometer and as well adapted for familiar popular use for the measuring of the humidity of the atmosphere, especially in living apartments and also in offices and factories and schools where so many of our waking hours are spent. As it is we suffer in health in comfort and in efficiency from humidity in summer and from aridity in winter, and while in these latter days there is more or less writing and talking about the matter little is being done toward the artificial control and correcting of the humidity of the atmosphere in which we pass our days and nights. Probably few realize how bad the conditions really are and probably they are no where worse than in the United States.

A recent issue of U. S. Public Health Reports tells of some observations made and the relative humidity of indoor and outdoor air in the winter time. It was found over a period of forty days of typical winter weather in a steam heated, well ventilated office kept at a temperature slightly above 70 deg. F., that the average indoor relative humidity was 23%. Observations also showed that this is about the humidity of the steam heated houses of the ordinary city of the North. The curious and the surprising thing is that this percentage of humidity is just the same as that observed in Death Valley, California, in the summer time.

There would seem to be little reason to wonder that diseases of the respiratory organs are all too common and only too fatal under these conditions. Arrangements should be carefully made—but where are they so made?—to prevent such extreme aridity in living rooms or the lungs lose most of their power to protect themselves against disease.

As to the excessive dryness of the air in our apartments in winter by artificial heating there is not much choice in the means employed, and ventilation, so-called, cannot efficiently help the matter. The average outdoor humidity on the days when the above indoor observations were made was 82%. Now if this outdoor air, with moisture somewhat in excess of the requirements for health and comfort, were merely heated to the indoor temperature without abstracting a particle of its moisture, it would show a relative humidity about as above reported. The apartments or offices spoken of above were steam heated, which means that there were radiators or systems of steam pipes internally heated by the steam and radiating heat from their external surfaces but contributing not a drop of water to the air. Steam heating by actually discharging clean steam into the air would be a very different proposition, but who ever does this, and why not?

There can be no perfect way of artificially correcting atmospheric humidity for indoor health and comfort except by actual transfer of sufficient moisture, putting some into the air in winter or abstracting some in the height of summer. The necessary arrangements would cost something, but would still be a bargain.

COMPRESSED AIR AND LEGISLATION

It is considerably embarrassing and far from promising of good results to be in a position which urges to action but which does not suggest what to do or how to do it. Judging by the achievements of various legislative bodies in the enactment of so-called laws for the regulation of compressed air practice and for the inspection of compressed air apparatus, they must have been tangled up in the quandaries here suggested.

It is well known that, very infrequently, air receivers explode, and sometimes with disastrous or fatal result. It is not so generally recognized that there are two distinct classes of such explosions. In the first of these, due to dead pressure and to the lack, at the moment, of sufficient opposing strength of material, the explosion which results is not at all comparable in destructive effect to that of a steam boiler, on account of the absence of the heat reserve of the body of water and the instantamous steam generating action accompanying the sudden release of pressure, so that the stringent regulations of the steam boiler code are unnecessary and unjust.

Explosions which may here be designated as of the second class are those in which an explosive mixture of air and of volatilized inflammable constituents of the lubricating oils is formed and by some means ignited. The force which may possibly be developed under these conditions is such that no safety valves and no ordinary strength of materials are sufficient to guarantee safety, and the most exacting boiler code does not meet the case. The legislation on record seems to justly and adequately deal with neither class of compressed air dangers.

The regulations relating to the safety of workers in compressed air in subaqueous tunnels and pneumatic caissons are editorially criticized in *Engineering Record,* March 10, as follows:

While it is undoubtedly to the pecuniary advantage of the "sandhog" to implant in the mind of the general public the idea that the personal risk involved in his calling greatly increases, and that hours of work should be shortened and pay increased for every five or six pounds increase in pressure above 22 lb. to the square inch, it is nevertheless a demonstrated fact that such is not the case. Notwithstanding that the best engineering authorities were aware of the real nature of the risks to men working in compressed air work prior to 1909, the New York State legislature in that year enacted a law embodying provisions for decreasing the working time until a point was reached at 50 lb., where the men spent as much or more time getting into and out of the air chamber as they spent at work. And now Pennsylvania is reported to be considering a similar law.

Contractors in New York State have not seriously protested against this law, because it places all of them on the same footing. Nevertheless the law, which contains several inconsistencies, has increased the cost of compressed-air work in that state, and is now in a fair way to be copied by another important state.

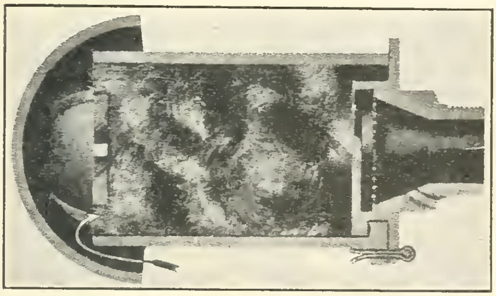
The best authorities on the subject of caisson disease assign as the cause of the disease the liberation of bubbles of nitrogen in the blood and tissues of the body during and after decompression. Since it has been demonstrated that the blood and tissues will dissolve nitrogen at the pressures encountered in compressed air work to 75 or 80 per cent. of complete saturation within a short period after entering the working chamber, it is evident that the argument in favor of short working periods, unless these periods could be made actually shorter than 45 minutes, is groundless. It is well understood that, unless poisonous gases are encountered, the chief danger of attack from caisson disease lies in decompression. Therefore it is doubtful whether, except for very high pressure, it does not actually increase the risk of inducing sickness to decompress the workmen from working to normal pressure twice daily instead of once daily.

Perhaps because the matter is much easier to arrange in tunnel work by reason of the space available in large tunnel bulkheads for additional locks, the New York law prescribes a much slower rate of decompression for tunnel workers than for caisson workers. The only argument in favor of this discrimination against tunnel work is that a caisson starts off at low pressure, the men working in it becoming gradually accustomed to the higher pressures and working under them in any one caisson only a few days. On the other hand, working conditions in caissons are usually considered more severe than in tunnels. It would, therefore, seem that a law which prescribed decompression for tunnel workers at the rate of 1 lb. per minute, while providing for decompression of caisson workers from given working pressures in definite intervals of so many minutes at much more rapid rates, is at least not based on scientific knowledge.

Another feature of this law that is detrimental to the safety of the workmen is that its wording definitely forbids stage decompression. In coming out of compressed air, it has been proved that the practice of reducing the air pressure rapidly to a point 20 lb. or more below the blood pressure will not give rise to the liberation of bubbles in the blood and tissues or to the symptoms of caisson disease. The law should permit stage decompression, known to be the safest method of bringing men out of compressed air, by stating that decompression should take a total time equivalent to a uniform reduction of 1 lb. per minute.

Before the New York law was enacted it was proved on the Pennsylvania tunnels under the East River that no valid argument based on additional safety to workmen can be made for decreasing the daily working period below 8 hours until a pressure of 32 lb. has been reached. Above this pressure, but below 42 lb. per square inch, the "sandhogs" on this contract worked 6 hours out of every 24, while above 42 lb. they worked 4 hours out of every 24. These working periods are much longer than those prescribed in the New York law, but it is a well-known fact that the work was carried out with a rate of sickness and death which is unusually low for such construction in New York City.

While these things are known to engineers familiar with work in compressed air, they are not known to legislators. The Pennsylvania legislature, which, it is understood, has in committee a bill similar to the New York law, should be informed on this subject by engineers before this bill can be enacted into a harmful statute. At least, those engaged in construction requiring the use of compressed air in caissons and tunnels should not sit by and allow the general public to gain the impression that the New York law and the law proposed in Pennsylvania represent the last word in safety practice for compressed-air workers when some of the provisions of these laws are actually more dangerous to workers than accepted engineering practice.



STRAINER FOR COMPRESSOR INTAKE AIR

The air filter or strainer shown in the halftone above is made by the Gustino Bacon Manufacturing Company, Kansas City, Mo., and is normally designed for air brake pumps on locomotives. It is made of malleable iron with either 1½ in. or 2 in. fittings, and weighs 8½ lb. It may be applied to the intake pipe of the air compressor in either a horizontal or a vertical position.

It consists of a 6 in. by 4 in. cylinder filled with oil-soaked curled hair through which the air must pass before it enters the compressor cylinder, thus cleaning the air of foreign matter. The strainer, as will be seen, is provided with a hemispherical hood which overhangs the outer wall of the cylinder for an inch or more, so that the air is drawn from inside the hood and not directly into the strainer. This construction prevents rain or snow from getting into the strainer and finally working into the cylinder. It also prevents the possibility of squirting oil into the compressor, a practice that is becoming too common with enginemen. The curled hair being soaked with oil will prevent the strainer from freezing in cold weather.

COST OF OXY-ACETYLENE WELDING OF PIPE JOINTS

Welded pipe joints are now so generally adopted and so economical and satisfactory for the transmission of service gas that we should be hearing also of their being used for compressed air line piping. The data following, embodying the most necessary details of information concerning them have been compiled by Mr. Chester Wilde, Engineer of Mains of the Philadelphia & Suburban Gas and Electric Company, Chester, Pa.

The joints spoken of are differently designated as requiring different times and different labor costs for their completion. The ditch joint is one made in the trench; the stationary joint one made above the trench, but without turning the pipe; and the turning joint the one made with the pipe being turned in order to bring the joint to the most convenient point for the operator.

A turning welded joint on an 8-in. pipe may be made in some instances in 20 minutes or it may take as long as 35 minutes, and yet there would be no difference in strength or in its quality as a gas-tight joint. This difference of time may be caused either by the chamber on the ends of the pipe being very uneven, or possibly due to one or the other of the ends of the pipe which is being welded having for a portion of its circumference an extra thickness of metal.

First, considering an average joint, and taking into consideration only the actual time necessary to make it, the cost will be:

Labor (including operator and helper)	$0.23
Acetylene	.38
Oxygen	.42
Filling iron	07
Total cost per joint	$1.10

or a total per foot of pipe laid (20-ft. lengths) of 5.5 ct.

The above cost being only for the actual time found necessary to make the joint, it will be obvious that, in order to arrive at a more clear understanding of the cost of the weld, the full cost or the time of the operator and helper in other work, such as setting the pipe for the joint, changing tanks, necessary in connection with the actual welding, should be added. This additional charge will increase the labor cost from 23 ct. to 41 ct., making the total cost of the joint $1.28 and the cost per foot of main laid 6.4 ct.

Still further considering the cost in addition to the labor cost necessary for the actual welding, add the labor cost found necessary when laying a main of the size being considered (8 in.) to place the pipe in position for the welder and helper, it will be found that there will be an additional labor cost of 18 ct. per joint, making the total cost of the joint $1.47, or a cost per foot of main laid of 7.3 ct.

The above costs were calculated from 327 joints made by three welders working ahead of the ditch.

Considering now the ditch and stationary joints, it would be found, if the maximum cost of these were taken, that in some instances they would be as high as three times that of the turning joint, depending upon the condition under which it is found necessary for the operator to work. First, considering the ditch joint, the average cost will be about as follows:

Labor	$0.45
Acetylene	1.06
Oxygen	1.20
Filling iron	.10
Total cost per joint	$2.81

The stationary joint will be found to cost somewhat less than the above and will aver- about as follows:

Labor	$0.30
Acetylene	.84
Oxygen	.96
Filling iron	.10
Total cost per joint	$2.20

From a careful study of these figures it will be at once apparent that every effort should be made to avoid these latter joints, as already shown, wherever possible. The joint in the ditch should only be resorted to when an obstruction compels its use. It will be found in the case of the stationary joint that an average of about fourteen men will be required for each mile of main laid. If good judgment is used and these expensive joints kept to a minimum, the average cost per joint or per foot of main laid will only be slightly increased.

Some engineers have thought that the extra cost of labor for handling the 40-ft. lengths of pipe would more than offset any saving which might be effected due to the reduction in the number of joints made per foot of main laid.

In order to arrive at an intelligent understanding on this subject, the average cost of 128 joints, or practically a mile of 8-in. main, using 40-ft. lengths, was calculated. The average cost, including all labor necessary, in addition to the operator and helper, for shifting the pipe ahead of the welders, showed as follows:

Labor	$0.95
Acetylene	.38
Oxygen	.42
Welding iron	.07
Total cost per joint	$1.82
Total cost per foot of pipe laid	$0.045

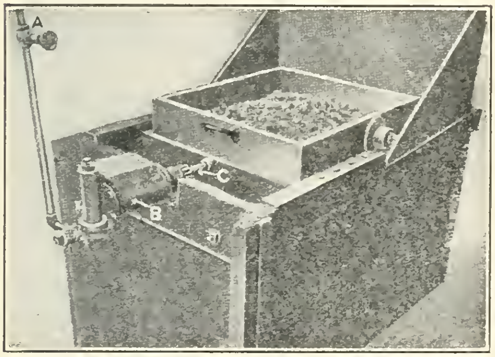
Thus it will be seen, by a reference to the maximum cost of a joint made when using 20-ft. lengths under the same conditions, the cost will be 35 ct. less than the joint of the 40-ft. lengths, but that the latter has a much less cost per foot of main laid, the difference in favor of the long lengths being 2.8 ct. These figures, however, do not take into account the possible extra cost due to cartage, which would probably decrease the difference per foot in favor of the 40-ft. lengths to about 2.3 ct.

The foregoing analyses of cost being all for 8-in. joints, it might be of interest to have, as a guide in order to arrive at the cost of mains of sizes from 1½ in. up, the actual cost of making the joints in the smaller sized pipe.

Table 1 shows these costs arrived at from tests made on joints from 1½ in. to 3 in. The actual time to make 4-in. and 6-in. joints would be about 14 and 20 minutes, respectively; and the cost would be about 55 ct. for the 4-in. and 70 ct. for the 6-in.

These tests show only the cost of labor actually required to make the joint, the costs, including all other necessary labor in connection with the weld, will be governed by the efficiency of the organization.

Size of pipe Ins.	Time Minutes.	Acetylene Cu.ft.	Oxygen Cu.ft.	Filling Iron oz.	Cost of weld.
1½	3	1.25	1.5	0.9	$0.08
1½	2	1.0	1.0	0.8	.06
2	5	2.0	2.25	1.1	.13
2	3	1.25	1.5	1.0	.10
3	7½	3.0	2.5	2.45	.19



A HANDY CHIP SEPARATOR

The half tone here reproduced from a recent issue of American Machinist shows one of these devices too numerous to mention which are constantly being devised in shops where a supply of compressed air is on tap. It is in use in the factory of the Wheeler-Schebler Carburetor Co., Inc., Indianapolis, and as will be seen is simply an air operated sieve for separating small manufactured articles from the fine chips with which they are mixed. Compressed air at the usual shop pressure passes through pipe A to air cylinder B. This cylinder is 2½ in. in diameter and the piston has 4 in. stroke, the red C connecting it with the sieve, which moving back and forth shakes out the chips into the box below. It will be noticed that the sieve has rollers on the side which enable it to move with very slight friction.

A BRITISH AUTHORITY ON THE METRIC SYSTEM

The following editorial note from *The Engineer*, London, will be found interesting without a word of remark or explanation from us.

We are invited by the Manchester and District Decimal Association to make a "sympathetic reference" to its work. It is difficult to do so without being misunderstood. The objects of the association are to introduce a new system of decimal coinage, based on the division of the florin into one hundred cents instead of ninety-six farthings, and the "compulsory use, after a suitable transition period, of the metric system of weights and measures in the United Kingdom, and, if possible, throughout the British Empire." Now there is a great deal that may be said in favor of the metric system, and were we invited to undertake the organization and management, under Providence, of a new earth we should probably adopt it in lack of anything better, but the problem is far less simple when the two greatest industrial communities in an existing world have got themselves so wrapped up and bound in by another system that to break away from it would involve enormous difficulties and incalculable expense. Thus far then we sympathize with the Manchester and District Decimal Association, that if things were not as they are we should be hand in hand with it. But things being as they are we cannot support a campaign for the "compulsory use" of the metric system. In accord with all other apostles of the metric system the Association is exercised in its mind about the loss of our foreign trade because we adhere to British measures. Surely all manufacturers who feel that they are losing foreign orders from this cause can do as many have already done, and quote for foreign work in metric figures. There is no need for compulsion, no need to force upon the country something it does not at present want. The law of the land sets up certain legal standards, but it compels their use in the case of a few commodities only. Nearly all manufactured goods may be sold to any standard the maker choose to employ, and if anyone desires to put on the British market machinery made to metric measurements he is at liberty to do so. It is open then to any firm to make according to British measures and sell in foreign parts according to metric, to make in metric measures and sell in Great Britain according to British measures, or finally, to make in metric and sell both at home and abroad in that measure and that measure only. In the course of time, ages perhaps, the matter would settle itself, and the metric system might become really universal, but as long as the two biggest industrial countries feel that its forced introduction would hinder rather than help their general trade then the world is not ripe for its adoption to the exclusion of all others.

NOTES

Miners' Circular No. 23, of the Bureau of Mines, says that injuries to the eye should be treated as follows: If the eye is badly hurt, as by a blast, it is best not to try to remove the bits of rock, etc.; quickly cover the injured eye with a bandage compress (not picric-acid gauze) or clean cloth or cotton, and tie loosely. Do not allow the patient to rub the eyes, but lead or carry him to a doctor as soon as possible. If the eye has merely a small piece of rock or other material in it, close both eyes for about half a minute and moisture from the eye may form and wash away the particle. If this remedy fails, close both eyes, pull the upper lid over the lower lid two or three times, close the nostril on the other side of the head with the finger, and blow the nose hard. Bandage the eye and wait for the doctor's aid.

We obtain from sugar about five times as many calories as from the same market value in beefsteak. We get from sugar three times as many calories at half the price we would pay for eggs, and our purchase of sugar will give us just about three times as much available energy as would the same amount expended for such a nutritious article as cheese.

We would not contend, of course, that sugar alone will provide a satisfactory diet or that it can be made to take the place of any of the other foods mentioned. But the truth remains that penny for penny we get far more actual energy from sugar than from any other commodity of everyday use, and that sugar is, therefore, the cheapest food we buy.

Small balloons carrying automatic registering apparatus and employed in investigating the upper atmosphere at Batavia in the island of Java quite near the Equator have given some interesting results. The mean temperature at sea level is 78.8 F. At a heighth of 2.92 miles the temperature was at the freezing point, 32 F., at 6.2 miles it was—29.2 and at 10.56 miles it was—119 deg. F. In England such extremes are not reached. At 6.2 miles the temperature is—59.8 and at 10.56 miles it is—65.2.

The *Cairns Post* of Australia relates with a good deal of interest, the excitement and wonder caused in a certain town by the arrival of huge grey objects resembling submarines, which, as everybody knows, go to the basement of the ocean their wonders to perform. However, these objects were not submarines, but next thing to it in this way: They were tanks loaded with molasses and sent to Cairns. The molasses is run into tanks within ships and taken south and is turned into an article used for the manufacture of explosives. Up to now the sugar industry has not been of any military importance save as a means of fortifying against hunger. Sugar has always been first in peace and it seems now it is to be first in war, for war is dependent on explosives first of all.

A gang of workmen engaged in blasting rock in the Twin Peaks tunnel at San Francisco returned to work after a round of shots had been fired and were caught by a delayed explosion. Twelve charges had been placed, the fuses ignited, and from a place of safety the shots were counted as they exploded. One missed fire, but was lost in the count, it being taken for granted that it had exploded simultaneously with one of the other shots. After the usual wait, the gang returned to work, and just as they reached the spot the delayed explosion occurred, killing the foreman and one laborer, seriously injuring two, and causing lesser injuries to five others.

High-class marine oil engines at the present time command a price of from $60 to $65 per horsepower. Figured on a pound basis, they sell at about 40 cents a pound net weight.

The following, worth reading, is from a Saturday Evening Post love story: When the discerning historian of 3000 A. D. writes of this century he will give less space to the great European war than to the development of gas motors. Already, incredibly, the motor vehicle has changed the face of the earth. It sends the most stodgy city dweller into places where he can find wisdom and fresh air; it has solved that ancient problem of the dissolution of the farm. It has transformed the ways of pleasure; it has even changed the life-old ways of love-making! Though poets still call our attention to roses, a poetry still more magnificent is being sung about us by popping — or sliding — valves. Something of this romantic miracle was realized in the humdrum offices of the, etc., etc.

A recent snowslide destroyed the compressor house and warehouse of the North Star Mine near Halley, Idaho, and fifteen men were killed. There was a full 30 inches of snow in three days followed by heavy rain.

LATEST U. S. PATENTS.

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

FEBRUARY 6.

1,214,531. POWER GENERATION. Reginald A. Fessenden, Brookline, Mass.

1. The combination of a combined liquid piston internal combustion engine and air compressor, and a turbine adapted to be driven by the compressed air, the liquid piston of the internal combustion engine and compressor being formed by a single column of liquid.

1,214,542. ROCK-DRILL. Charles H. Haeseler, Philadelphia, Pa.

1,214,603. ROCK-DRILLING APPARATUS. William A. Smith, Denver, Colo.

1,214,604. DRILL-SHARPENING APPARATUS. William A. Smith, Denver, Colo.

1,214,607. ROCK-DRILLING MACHINE. William Charles Stephens, Cornwall, England.

1,214,614-5. FLUID-PRESSURE BRAKE APPARATUS. Walter V. Turner, Edgewood, Pa.

1,214,616. ELECTROPNEUMATIC BRAKE. Walter V. Turner, Edgewood, Pa.

1,214,637. AERATING DEVICE. Oscar Zistel, Sandusky, Ohio.

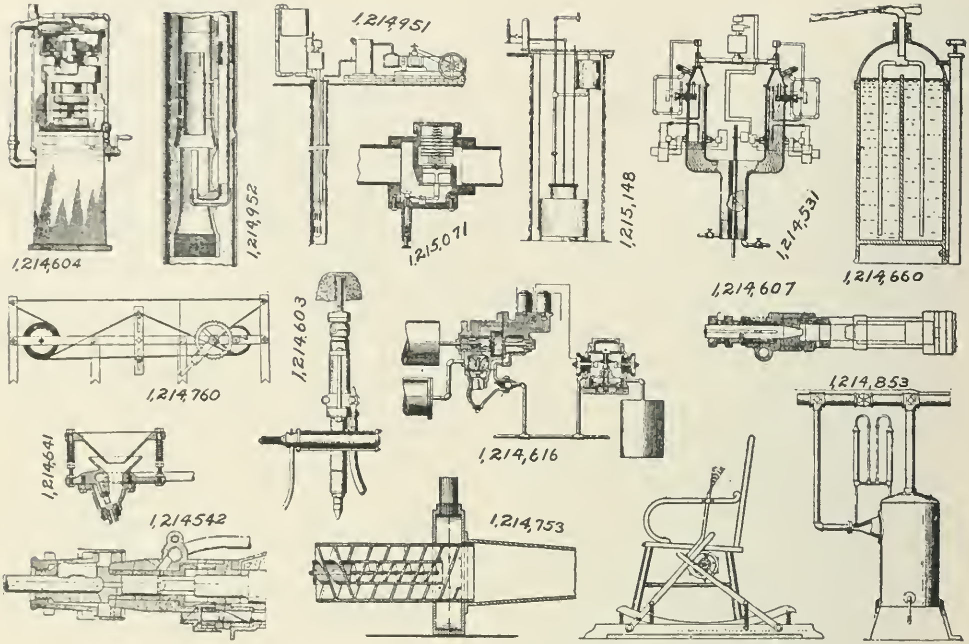
1,214,641. SAND-BLAST APPARATUS. Clarence E. Billings, New Haven, Conn.

1,214,660-61. FOAM-GENERATING APPARATUS. James B. Erwin and Orlando R. Erwin, Milwaukee, Wis.

1,214,665. ROCK-DRILL. Seymour Ferguson, Ocotlan, Mexico.

1,214,727. WELDING-TORCH. Rudolph Vuilleumier, New Rochelle, N. Y.

1,214,753. SYSTEM FOR FEEDING PULVERIZED FUEL. Virginius Z. Caracristi, Albany, N. Y.



Pneumatic Patents February 6

1,214,760. APPARATUS FOR FILTERING AIR. Sutton Cooper, Evansville, Ind.

1,214,811. PNEUMATIC VEHICLE-WHEEL. Luis Mayolino, Habana, Cuba.

1,214,853. APPARATUS FOR INDICATING THE RATE OF FLOW OF FLUIDS IN PIPES. Charles L. Weil, St. Clair, Mich.

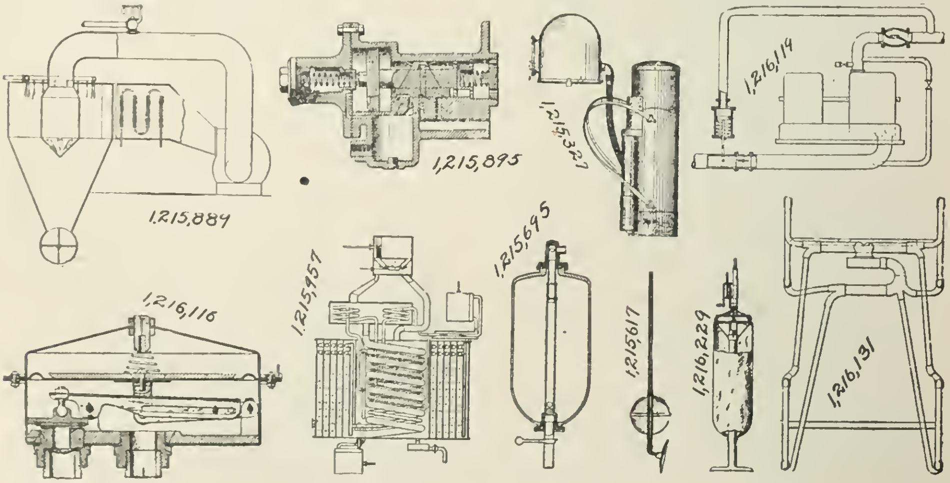
1,214,865. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. Morris S. Wright, Worcester, Mass.

1,214,902. AIR AND WATER SEPARATOR. Lincoln S. Deal, Kalamazoo, Mich.

1,214,943. ACCENTING DEVICE FOR MECHANICAL MUSICAL INSTRUMENTS. James O'Connor, New York, N. Y.

1. A pneumatic player for musical instruments including in combination an air pump, an equalizing reservoir communicating therewith, an actuating pneumatic communicating with said air pump and governed thereby, and means actuated by said actuating pneumatic for restraining the operation of said equalizing reservoir.

1,214,951. AIR-LIFT SEPARATOR-PUMP. Oran M. Pruitt, Indianapolis, Ind.



Pneumatic Patents February 13

1,214,952. AIR-LIFT. Oran M. Pruitt, Indianapolis, Ind.

1,215,071. UNLOADING-VALVE FOR COMPRESSORS. George F. Steedman, St. Louis, Mo.

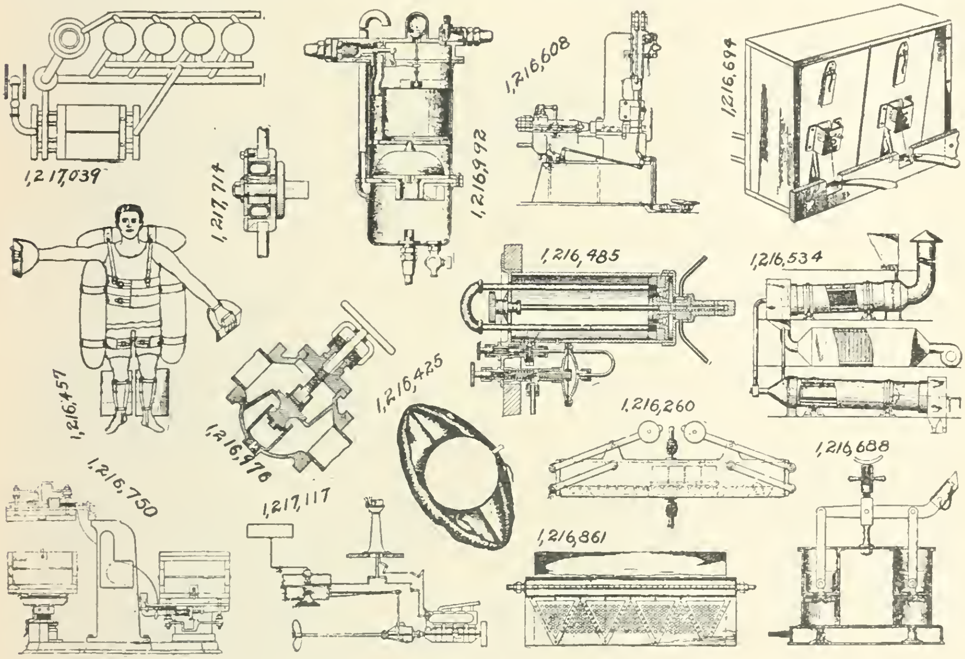
1,215,103. CHAIR-ACTUATED BLOWER. Michael Blanarik, South Norwalk, Conn.

1,215,148. PUMP. Joseph C. Harbison, Eldorado, Ill.

1,215,192. STEAM-DRIVEN AIR-COMPRESSOR. Dominick A. Reagen, Altoona, Pa.

1,215,221. APPARATUS FOR RAISING WATER. Frederick H. Umholtz, Oklahoma, Okla.

An apparatus of the character described comprising a pair of water containers adapted to be lowered within a water well spaced from its bottom and having valved inlets, a compressed air tank adapted to be located exteriorly of the well, a water discharge pipe common to said containers, a gear casing arranged in said discharge pipe, gear wheels journaled in the casing and meshing with each other, a valve casing connected with the gear casing and having dual communication with the compressed air tank, the said valve casing having a pair of exhaust ports, branch air supply pipes leading from the valve casing to the container, and a valve within the casing having driven connections with one of the gears in the gear casing and adapted to alternately allow admission of air to one receptacle and the exhausting of air from the other receptacle.



Pneumatic Patents February 20

FEBRUARY 13.

1,215,327. RESPIRATORY SYSTEM FOR SMOKE-HELMETS. Charles H. Ackerman, Milwaukee, Wis.

1,215,617. BUBBLE-BLOWER. Rafael Diaz Buitrago, New York, N. Y.

1,215,621. PNEUMATIC GOVERNOR. Herbert W. Cheney, Milwaukee, Wis.

1,215,695. FLUSHING APPARATUS WITH AIR-CHAMBER. Frederick Johannes Paff, Utrecht, Netherlands.

1,215,889. PROCESS AND APPARATUS FOR DESICCATING FLUID SUBSTANCES. Richard W. G. Stutzke, Chicago, Ill.

1,215,890. DUST-SEPARATOR. Harry A. Thuneman, St. Louis, Mo.

1,215,895. COMBINED AUTOMATIC AND STRAIGHT-AIR VALVE MECHANISM. John A. Adams, Nogales, Ariz.

1,215,957. APPARATUS FOR LIQUEFYING AND SEPARATING GASES. Rudolf Mewes, Berlin, Germany.

1,216,116. FLUID-PRESSURE GOVERNOR. Harold A. Hayward, New York, N. Y.

1,216,119. ROTARY COMPRESSOR AND THE METHOD OF OPERATING IT. Adolf Hinz, Frankfort-on-the-Main, Germany.

1,216,131. MEANS FOR PREVENTING THE RAISING OF DUST BY MOTOR-VEHICLES. Benjamin Jones and Phillip John Rees, Gwaun-Cae-Gurwen, Wales.

1. In means for preventing the raising of dust by the wheels of a motor vehicle, the combination with a vehicle, of pipes having mouth pieces arranged in front and rear of the wheels adjacent the treads thereof and close to the ground, and an air apparatus connected with the said pipes and drawing in the air in front of the wheels and delivering it to the rear of the wheels.

1,216,229. VACUUM-CLEANER. Bertie R. Hall, Outlook, Saskatchewan, Canada.

1,216,254. AIR-SPRING. Lucien R. Gruss, San Francisco, Cal.

FEBRUARY 20.

1,216,260. VACUUM-BOX FOR FRUIT-CANNING. Lewis E. Arnold, Honolulu, Hawaii.

1,216,425. INFLATABLE TOY. Moses H. Eiseman, Chicago, Ill.

1,216,457. SWIMMING DEVICE. Martin Jelalian, Cranston, R. I.

1,216,485. COMPRESSED-GAS CONTROLLING AND IGNITING MECHANISM FOR AUTOMOBILES. Charles J. Pembroke, Rochester, N. Y.

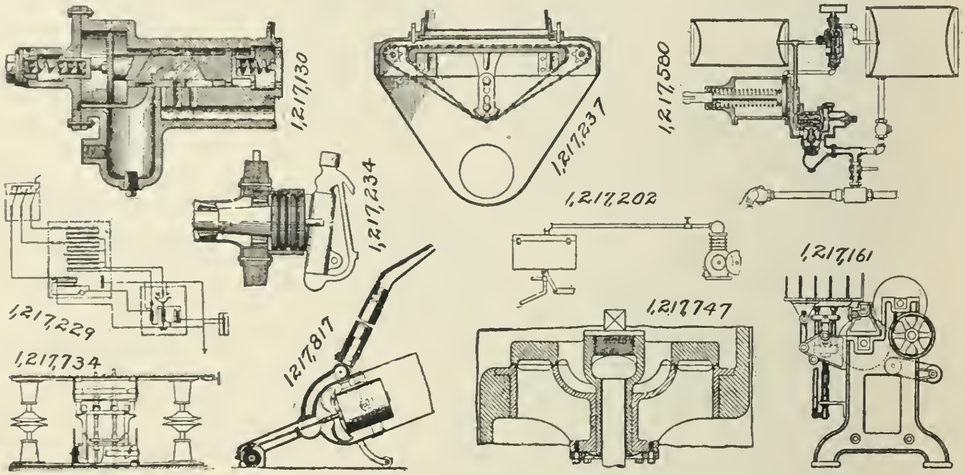
1,216,542. VACUUM-OPERATED BRAKE MECHANISM. Robert F. Berkebile, Kantner, Pa.

1,216,554-5. PROCESS OF GRANULATING AND DRYING SUGAR. Godfrey Engel, Brooklyn, N. Y.

1. The process of drying sugar that consists in disseminating wet sugar in an air passage, disseminating nearly dried sugar in a second air passage and passing air through the second passage and thence through the first passage with the addition of fresh air, whereby the dry sugar dust from the second passage is intercepted by the moist sugar in the first passage.

1,216,608. POWER-HAMMER MECHANISM. Samuel V. Rawlings, Calumet, Mich.

1. In power hammer mechanism, the combination of a hollow frame forming a supply reservoir for motive fluid, a hammer operating motor cylinder mounted on said frame and connected to the supply reservoir therein, and controlling valve mechanism for said motor cylinder.



Pneumatic Patents February 27

1,216,664. DRIVING MECHANISM FOR SELF-PROPELED BODIES. Frank W. Dodd, Brooklyn, N. Y.

1. An automobile torpedo and a driving mechanism therefore comprising an engine arranged to be driven by the water in which the torpedo is immersed or on which it floats, and fluid pressure means operated by expansion of gas derived from a source of reservoir, kept at continuous pressure for forcing the water through the engine, the water after passing through the engine being exhausted into the surrounding water in a rearward direction.

1,216,677. APPARATUS FOR PURIFYING BLAST-FURNACE GASES. Martin Ernest Feilmann, Donald Bagley, and Arthur Herbert Smith, London, England.

1,216,688. TIRE-INFLATING PUMP. Joseph Heeley, Wigan, England.

1,216,693. BELLOWS FOR PNEUMATIC LEAF-TURNERS. Jarret C. Holcom, Sulphur Springs, Tex.

1,216,714. PNEUMATIC WHEEL. John W. Martin, Pittsburgh, Pa.

1,216,722. APPARATUS FOR IMPREGNATING LIQUIDS WITH GAS. Harrison E. Patten, Silver Spring, Md.

1,216,750. SAND-MOLDING APPARATUS. Henry Tscherning, Freeport, Ill.

1,216,761. WATER-SUBMERGED AIR-CHAMBER FOR WATER-PIPES. Howard H. York, Logansport, Ind.

1,216,841. AIR-BRAKE-OPERATING MECHANISM. William C. Renshaw, Mannington, W. Va.

1,216,861. SUCTION-BOX. Napoleon Shorey and Francis P. Flynn, Woodland, Me.

1,216,976. COMBINED STOP-VALUE, AUTOMATIC LIMITED-PRESSURE VALVE, AND FULL-PRESSURE SUPPLY-VALVE. Thomas Burton Ford. Brooklyn, N. Y.

1,216,992. VACUUM-OPERATED LIQUID-FUEL-FEEDING DEVICE. Edgar R. Hawley, Salt Lake City, Utah.

1,217,039. PREHEATING OF AIR FOR HOT-BLAST STOVES OF BLAST-FURNACES. Edward E. Marshall, Philadelphia, Pa.

1,217,117. FLUID-ACTUATED MEANS FOR CONTROLLING AN ENGINE. William H. Curtis, Portland, Ore.

FEBRUARY 27.

1,217,130. COMBINED AUTOMATIC AND STRAIGHT AIR VALVE MECHANISM. John A. Adams, Nogales, Ariz.

1,217,161. PNEUMATIC PRESS-FEEDING MEANS. James Duvall, Camas, Wash.

1,217,202. SANDER FOR VEHICLES. Arthus R. Morrissey, Seattle, Wash.

1,217,229. ELECTRIC AIR-HEATING SYSTEM. Elmer J. Smith, Detroit, Mich.

1,217,234. INFLATING SYSTEM. Benjamin O. Stark, Stotesbury, Mo.

1,217,237. PULVERIZED-FUEL FEEDER. Edwin Fergerson Stewart, Woodcliff, N. J.

1,217,580. AIR-BRAKE SYSTEM. Frank H. Dukesmith, Buffalo, N. Y.

1,217,734. AUTOMATIC RAILWAY-CAR AND COMPRESSED-AIR AND STEAM PIPE COUPLING DEVICE. Cesare Feroci, Rome, Italy.

1,217,747. FLUID-PRESSURE VALVE. John Graham and Archibald Graham, Glasgow, Scotland.

1,217,817. VACUUM-CLEANER. Homer L. Peters, Salem, Ohio.

1,217,824. INFLATED APPARATUS FOR PREVENTING DROWNING AND ASSISTING SWIMMING. John James Pritchard, Moseley, Birmingham, England.

1,217,886. PNEUMATIC MASSAGE APPARATUS. Harvey L. Hopkins, Chicago, Ill.

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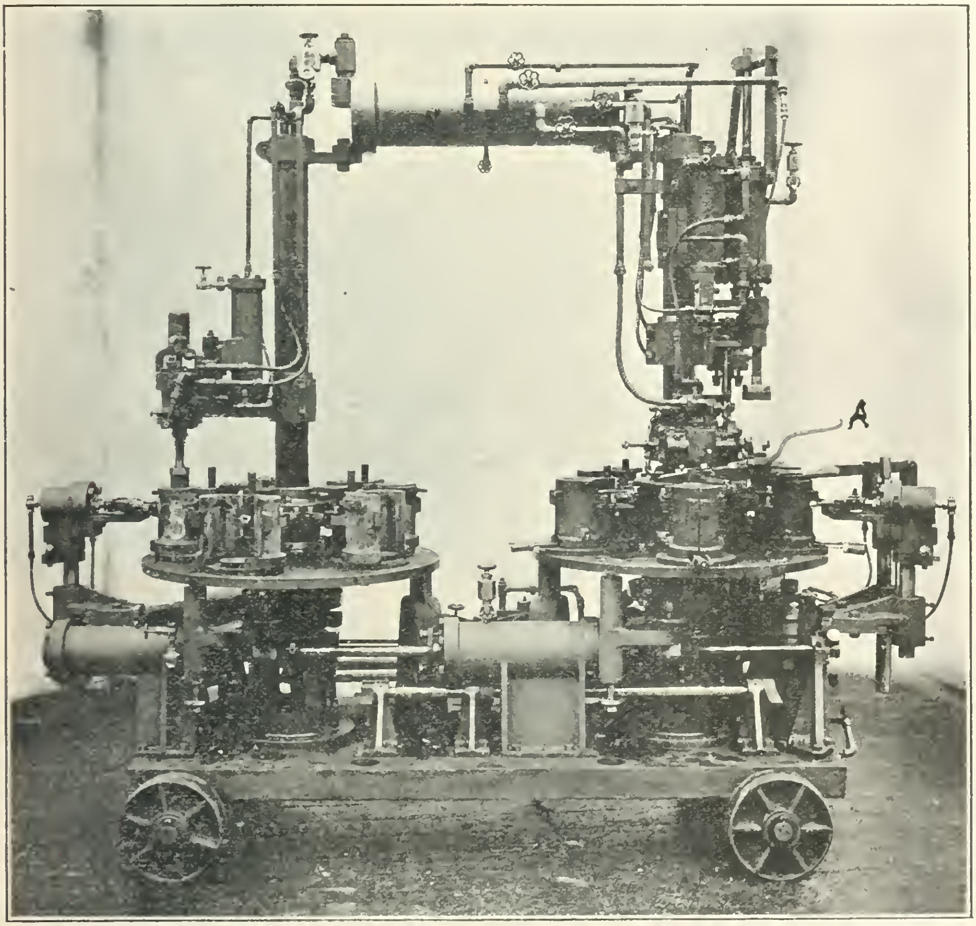

FIG. I. MACHINE FOR NARROW NECK BOTTLES.

AUTOMATIC BOTTLE BLOWING MACHINES

The photos here reproduced show as two interesting and ingenious machines in extensive practical use for the manufacture of bottles. They are built by the Cox and Sons Company, Bridgeton, N. J., and are extensively employed not only in the United States but in many foreign countries.

The machine shown in Fig. 1 is exclusively for the manufacture of narrow mouth bottles, such as used for beer, soda water, catsup, proprietory medicines, etc. It is not practicable to describe the machine in detail for the general reader. It is a machine of numerous movements and these are all produced by compressed air, the several operating air cylinders being sufficiently in evidence. The operating pressure is from 20 to 35 lb. gage, this requiring to be adjusted and controlled with considerable nicety, and is accordingly taken care of by pressure regulators in the air supply system.

The molds for the bottles are shown upon the two intermittently rotating tables, the molds at the right being closed and those at the left being open. The end of the machine at the right of the picture is placed close to a glass melting furnace, and here a gathering boy inserts his gathering iron into the molten glass, turns to the machine and trips the lever *A* with his gathering iron. This trip lever admits compressed air to the machinery, first operating a set of shears which cut the required quantity of glass from the gathering iron, this glass then dropping into what is known as a blank mold. There then automatically descends a blow back cap, closing the end of the mold into which the glass has been dropped. Air is then introduced into the lower end of the blank mold, this forming the glass into what is known as a glass blank, and a plunger is inserted to form the mouth of the bottle. It then passes to the second stage and the third stage successively and then is removed by a transfer boy. In this transfer the glass blank is inverted and placed in the blow mold on the second table, it now being in the normal upright position. The operation of blowing the glass blank into a finished article is completed by the several operations in the rotation of the second table and the bottle is removed at the taking out point by a small boy.

It would be impossible to follow the passage of the air in this machine if a detailed description were attempted for the reason that the various passages and air connections cannot be traced in the photogragh. It is sufficient to say that when the air is introduced into the machine it passes from point to point, first performing one operation and then another, many operations taking place, such as the cutting, the forming and the solidifying of the blank, the absolute locking of the molds, the precise turning of the tables, etc.

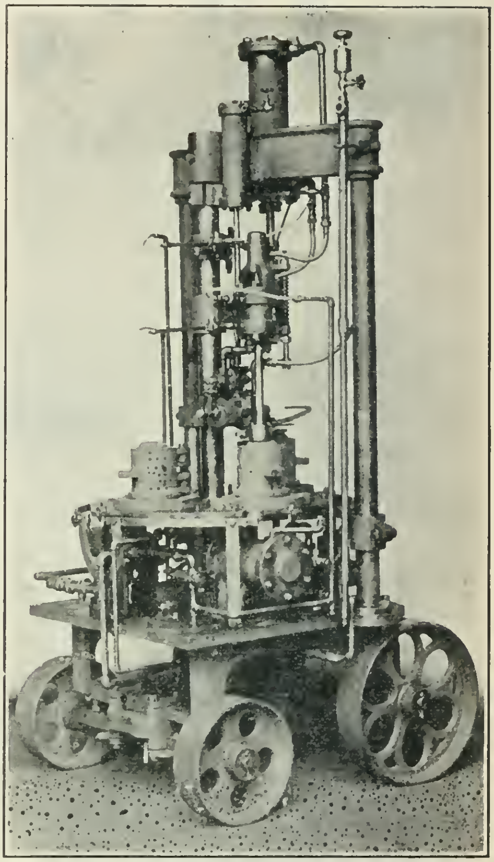

FIG. 2.

These motions are so timed that 12 to 15 bottles per minute are produced without intermission for 18 or 24 hours a day, 10 months in the year. The intricacy and the precision of construction and operation of these machines speaks for itself.

The necessity of uninterrupted operation of the machines may be appreciated from the fact that a stoppage of only three minutes for any adjustment will make a delay of 15 minutes until the bottles begin to be delivered again in acceptable condition. This is due entirely to conditions of temperature which are disturbed by the stoppage, the heat of the glass itself when in steady operation being the correct adjusting medium.

The machine shown in Fig 2 is for the manufacture of wide mouthed ware. Practically the same principles are involved, but the glass blanks are formed in a different manner and the transfer of the glass blank from the blank mold table to the blow mold table is accomplished mechanically, so that this machine requires only one skilled gathering boy and one unskilled small boy to remove the finished bottles.

THE HAND PROCESS OF WINDOW GLASS MANUFACTURE

BY ROBERT LINTON*

Glass does not have a definite melting point, in the sense of a fixed temperature at which it passes from a solid to a liquid state. Strips of window glass have showed a slight deflection at 840 deg. F., while they lost stiffness at 920 deg. and bent freely at 980 deg. The glass becomes softer as more heat is applied, and at 1,700 deg. it becomes so liquid as to readily assume the shape of a vessel into which it is poured. With the application of more heat the glass becomes still more and more fluid until finally a point is reached where a slight decomposition and loss of alkali takes place, which manifests itself by bubbles of gas rising through the heated mass.

PLATE GLASS AND WINDOW GLASS

There are two kinds of transparent sheet glass, termed commercially plate glass and window glass, manufactured by two radically different operations. In making the former, a quantity of molten glass is poured upon a casting table and rolled out in a sheet which is placed in a kiln where it is annealed and cooled. The sheet produced in this way is rough, as the metal table and roller, no matter how smooth, will leave an impression on the soft glass; consequently it has to be ground down to a plane surface on both sides and then polished in order to render the surface smooth and the sheet transparent.

Window glass is made by blowing or drawing a cylinder in such manner that nothing but air comes in contact with the surfaces during the operation, cutting open the cylinder longitudinally, reheating it, and flattening it out in a sheet which is then annealed.

In the hand process of manufacture, which only began to be superseded in 1903, the tool used is the blowers pipe, about five feet long, with a mouth piece on one end, and on the other the belt-shaped wrought iron "pipe head." The workmen are the blower, the gatherer and the snapper, or blower's helper, the three men constituting a "shop." The gatherer starts the operation by dipping the pipe head, which has been previously heated, into the molten glass which adheres and forms a small ball. He blows through the pipe sufficiently to expel the soft glass from the interior and form a small bubble in the ball. The glass is then cooled to the proper stiffness, more glass is gathered and the operation repeated until there is sufficient glass to yield a cylinder of the desired size. For an ordinary cylinder the gatherer usually gathers five times.

The lump, which is in a state of rather stiff plasticity, is then carried to the "blower's block," an iron mold set in water to keep it from becoming too hot, and lined with charcoal to prevent the glass from being marked by contact with the iron. By turning the ball in the block, blowing air into the lump through the pipe and drawing it up towards him, the blower so manipulates the operation as to form a pear-shaped ball, the upper part of which has the diameter and thickness of the cylinder to be produced, the bottom containing a thick mass of glass that has now become quite stiff. The ball is now reheated in a "blow furnace" and when soft enough, the blower swings it out in a "swing hole" alongside the blow furnace. The weight of the glass elongates the cylinder and the blower keeps it distended to proper diameter by intermittently blowing air into it through the pipe. The reheating and swinging out is repeated until the glass in the closed end of the cylinder is of the same thickness as the other parts. This closed end is now exposed to the heat of the blow furnace, the workman at the same time blowing into the pipe and keeping the air confined by holding

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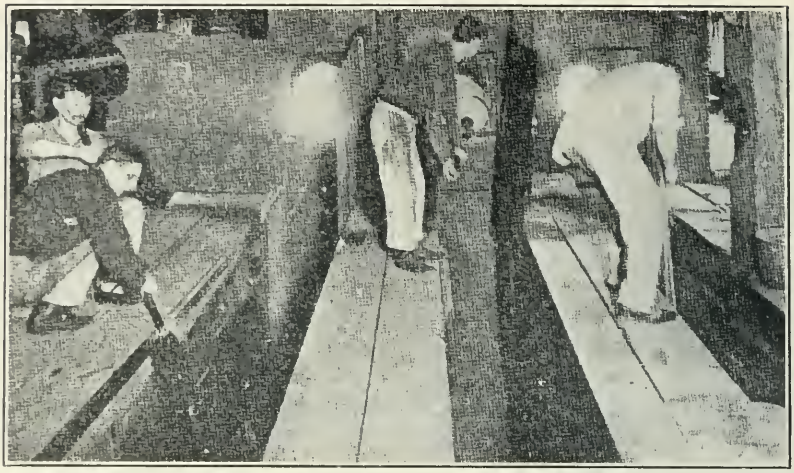
*From a Paper before the Engineers' Society of Western Pennsylvania.



HAND BLOWING OF WINDOW GLASS.

his thumb over the mouth piece. The glass in the end softens, and the heat at the same time expands the air in the cylinder, which finally bursts out through the end. The open end is heated still further and swung out into the swing hole in such manner as to make it cylindrical to the end. The pipe is removed by touching a cold iron to the glass just below the pipe head, and the pear-shaped cap removed by stretching a thread of hot glass around the cylinder, allowing it to remain until a heated streak is formed, and touching this streak with a cold iron causes the cap to snap off. The cylinder is split by passing a hot iron back and forth through the cylinder to produce a similar line of heat and touching it at one end with a cold iron, which results in a straight crack from end to end.

The cracked open cylinder is then carried to a flattening oven. It is laid on an iron carriage and pushed into the oven, where it is heated, lifted with an iron tool from the carriage and laid on the flattening stone—a large, flat fire clay tile with a carefully levelled and highly polished surface. As the glass softens the cylinder is spread out and then rubbed down flat with a wooden block mounted on a light steel bar. The stone with the sheet lying on it is then moved out of the flattening compartment into a cooler one, the sheet is gradually cooled down and when it is sufficiently hardened, it is lifted by means of a fork with smooth steel tines and laid on a conveyor which carries it slowly out of the oven. This part of the oven, called the "lehr," is for the purpose of annealing the glass by cooling it slowly and gradually, for otherwise it would be too brittle for commercial use. The ordinary type of flattening oven has four flattening stones set on a circular table—the "wheel"—which is carried on a vertical shaft turned by hand from a bevel gear drive.

It will be readily appreciated that blowing window glass requires unusual judgment and manual skill, as well as more than ordinary physical strength and endurance; also that the size and thickness of sheets that can be produced by hand is quite limited. In single strength (1-12 in. thick) the limit is about 14 in. diam. by 60 in. long; in double strength (1-8 in. thick) about 19 in. diam. by 70 in. long.

The workers were extremely well paid. Blowers' wages ordinarily varied from about $150 to $250 per four weeks, and gatherers from about $110 to $150. Blowers who made the largest sizes were paid much more than this. I remember one "big blower" in a factory with which I was connected who earned $642 in four weeks.

By August the Government expects to get from American sources all the dyes it uses in printing stamps, paper currency, and the like.

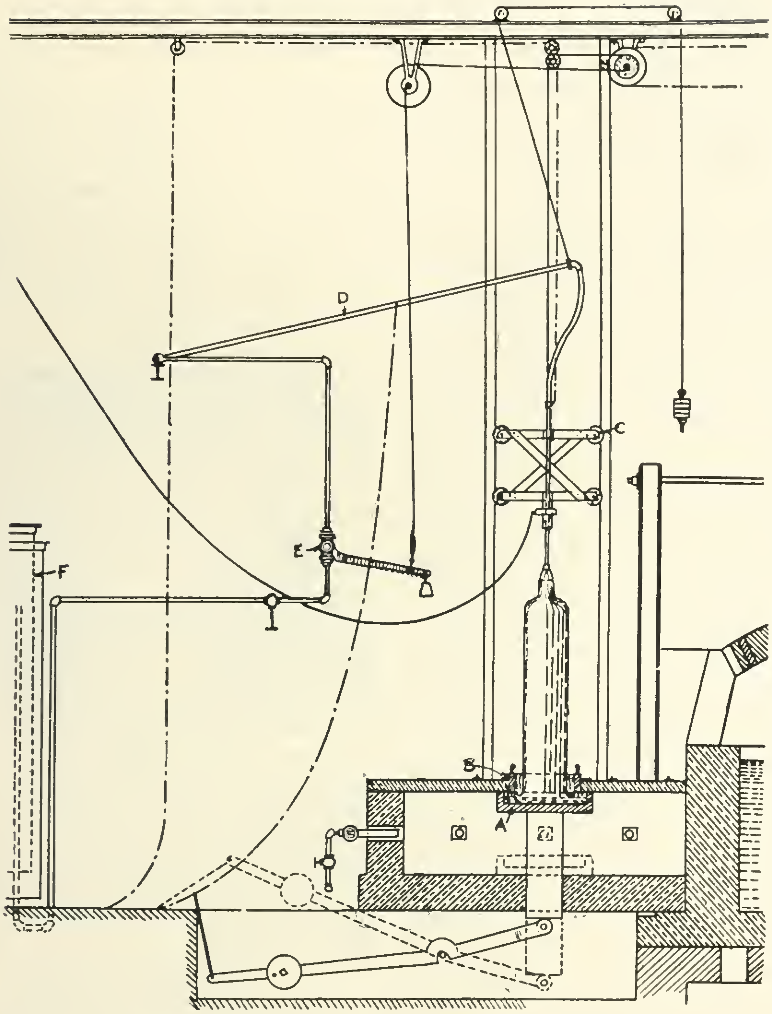


FIG. I. SKETCH OF FIRST WINDOW GLASS MACHINE.

WINDOW GLASS BY MACHINE*

BY ROBERT LINTON

Somewhere around 1896 John H. Lubbers, a window glass flattener by trade, began experimenting with a machine to make glass cylinders. A small company was formed for the purpose of carrying on the experiments, but it required years of work and an enormous amount of money to develop the apparatus to the point where it was finally operated at a profit.

The Lubbers process is for drawing cylinders vertically from a bath of molten glass, and Fig. 1 is a sketch of the first machine ever successfully employed for the purpose. A is a flat bottomed, circular pot placed in a heated kiln and movable vertically; B is a circular water cooled shield; C is a crosshead traveling on guides, raised by means of a cable winding on a cylindrical drum and carrying a detachable blow pipe of the general type used in hand blowing; D is a supply pipe for the admission of air under sufficient pressure to keep the cylinder distended to proper diameter; E is a graduating valve which is automatically opened as the crosshead C is raised, the valve being provided with a slotted opening of proper size and shape to admit the requisite quantity of air at each point of draw; F is a gasometer serving to maintain a constant pressure in the supply line conveying air to the graduating valve.

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*Abstract from Engineers' Society of Western Pennsylvania

The operation was as follows: The pot A was raised to the top of the kiln and the water shield placed in the position shown. A quantity of glass sufficient for drawing one cylinder was ladled into the pot. A ball of glass was gathered on a blowpipe, the small bubble blown out as in hand blowing, and the ball "marvered," or rolled on a smooth iron plate, so as to thin the bottom portion beneath the bell shaped end of the pipe; the pipe was then hung on the crosshead and lowered into the glass. The crosshead was then raised, air being admitted by the operation of the graduating valve, which swelled out the glass to the diameter of the cylinder to be drawn. The upward movement was then continued until the cylinder reached the desired length, the introduction of air being automatically regulated by the graduating valve. The cylinder was severed from the glass remaining in the pot in any one of several ways—either by dropping the pot and allowing the heat to melt the lower end, by shearing off, or by shutting off the air and continuing the upward movement, which contracted the lower end of the cylinder to a small cord which was sheared off. The pipe with cylinder attached was removed from the cross-head, lowered to a horizontal position, the pipe removed and the cylinder capped off as in hand blowing operations. The pot was lowered to the kiln to reheat it and melt to proper consistency the residue of glass that remained in it.

The control of the machine by the operator was at that time limited to stopping, starting or reversing the drum on which the cable wound that raised and lowered the crosshead, and in manipulating a hand valve on the air supply line between the gasometer and the graduating valve.

Out of this crude apparatus, and after years of costly experimenting, was perfected a machine that is producing to-day results far beyond the most optimistic expectations of its inventor. One by one the causes of the troubles were located and the apparatus modified or adjusted to correct them.

That this work was so slow and so difficult was largely due to two facts which have been mentioned, viz.: First, that in the liquid state in which glass is worked in machine operations, it is so soft as to be extremely sensitive to changes in temperature or variations in exterior or interior pressure exerted at the point of draw; and second, that in working glass, cooling strains develop as the glass passes from the liquid to the solid state, causing brittleness.

The method of reheating the residue remaining in the pot after drawing a cylinder and then ladling fresh glass into the pot was not very satisfactory. It was difficult to get good quality of glass, for unless the glass in the pot and that which was ladled into it were heated to the same temperature and brought to a very fluid condition, they would not mix properly, and thus streaks would be produced.

It was then proposed to drain the pot between the draws, and to accomplish this a furnace was built with four pots mounted on a turn-table and so arranged that each pot would be tilted at a certain point. In this way there would always be one pot used for drawing cylinders while the others would be heating and draining. An improvement on this apparatus was the double reversible pot mounted on trunnions shown in Fig. 2, in using which one side was always being drained while a cylinder was being drawn from the glass on the other.

THICK AND THIN SIDES

It was also discovered that there was gradual cooling of the glass during the draw, and that is was important to control this so as to prevent one side from cooling more rapidly than the other as far as could be done. The effect of inequalities in the temperature of the bath is to produce "thick and thin" glass, i. e., that portion of the circumference of the cylinder where the glass is coolest at the point of draw will always be the thickest; also in many cases this inequality in temperature causes the cylinder to travel towards one side of the pot instead of continuing to draw vertically from the starting position. A great deal of difficulty was experienced in eliminating this "thick and thin" glass, as it could be

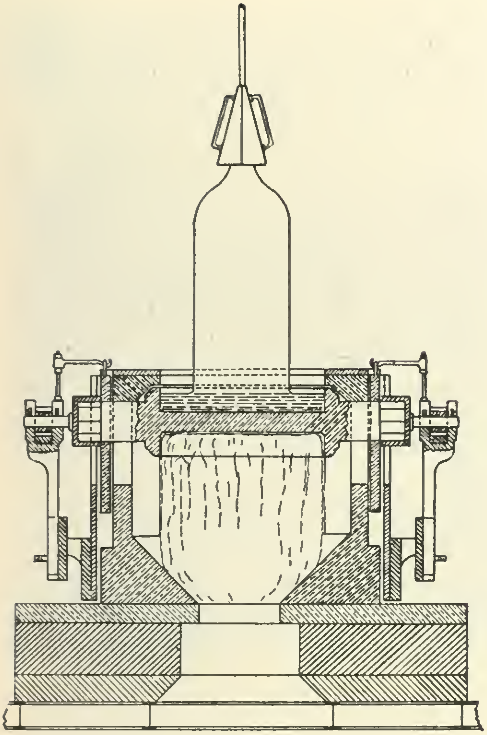


FIG. 2.

due to a number of causes. More positive adjustment of the machinery, an improved type of ladle and method of ladling the glass from the tanks to the pots, more care in keeping the pots uniformly heated, and shielding the glass bath from draughts, very greatly reduced the proportion of "thick and thin" glass produced. It was, however, found so difficult to maintain absolute uniformity in the temperature and rate of cooling of the bath, that the practice was finally adopted of drawing from the center of average viscosity, instead of from the center of the pot. In other words, when the glass in a place is thick and thin, and the apparatus is in proper condition, the blow pipe is simply moved sufficiently to bring the thickness uniform or practically so for the entire circumference of the cylinder.

It was thought in the early days of machine operations that some change in the chemical composition of the glass, or in the character of the materials from which it was made, would be necessary in order to adapt it to the new working conditions. The cylinder was now being drawn from glass in a liquid condition, while the hand blower manipulated a lump sufficiently stiff to be retained on the end of the blow pipe. The glass was worked out of the tank much more rapidly, which accelerated the flow proportionately. The maximum amount of glass gathered in 24 hours from one of the tanks under hand operations was 3.7 per cent. of the total contents, while under machine operations more than 20 per cent, has been ladled from the same tank in 24 hours.

INCREASING THE SIZE OF CYLINDERS

The original Lubbers' machine made a cylinder about the size of a hand blown cylinder, but it soon became obvious that production could be materially increased by ladling a larger quantity of glass into the pot and drawing a longer cylinder. This introduced complications in the control of drawing speed and air supply, but eventually the point was reached where five flattening lengths about 14 in. in diameter by 60 inches long could be produced at one draw.

The next step—and a most important one in increasing production—was to increase the diameter of the cylinder. It was not possible to flatten a single strength cylinder that was much larger than the standard size of 14 in. in diameter by 60 in. long. It was suggested, however, that there would not be any difficulty in flattening if the conditions should be reversed and flattening lengths produced which would be 19 in. diameter by 42 in. long, employing of course pots of larger diameter and containing a larger quantity of glass. The size of the cylinders has since then been considerably increased, so that to-day, using a 36 in. pot, single strength cylinders are made up to 21 in. diameter by 460 in. long, and double strength up to 24 in. diameter by 320 in. long.

REGULATING THE AIR PRESSURE

Lubbers had discovered three fundamental facts in his earlier experiments: First, that the air supply must be held at constant pressure; second, that unless the quantity of air supplied to the interior of the cylinder was constantly and uniformly increased during the drawing operation, the cylinder would taper off to a point; and third, that no ordinary type of hand manipulated valve on the air

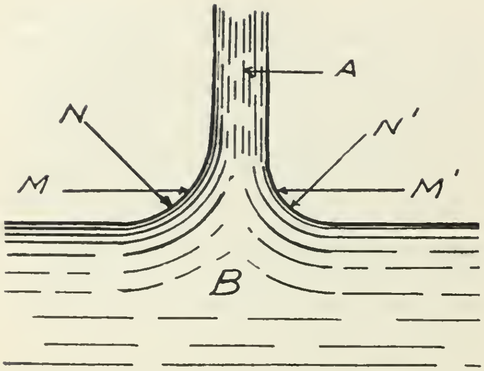


FIG. 3.

inlet line would regulate the increase delicately enough. These conditions were provided for by using a gasometer for regulating the air pressure and a special automatic graduating valve for controling the rate of increase of the air supply.

SURGING

As the length of the cylinders was increased another complication entered. It was found that even with the graduating valve opening and increasing with automatic precision the amount of air entering the cylinder, the pressure at the point of draw was not constant, but was applied in a series of surges which produced corrugations in the cylinder, termed "pulsations." For the purpose of better understanding the cause of these let us consider the condition of the glass at the point of draw, and some of the factors affecting the air pressure inside the cylinder.

In Fig. 3, A represents the wall of a cylinder being drawn from the bath of liquid glass B. The surface tension of the glass in the meniscus outside of the cylinder is N, and N' the surface tension of the meniscus inside the cylinder. Now N will always be greater than N', because the surface of the glass in the pot outside of the cylinder cools by free radiation and convection in the atmosphere, while the surface of the glass inside cools by radiation through the cylinder and convection currents set up by what air is confined within the cylinder. The difference is doubtless very slight at the beginning of the draw, but increases gradually as the draw progresses. Now since N is greater than N' the wall of the cylinder will be gradually pushed over towards N', unless held out by pressure. If we call M and M' the horizontal components of the force due to surface tension on the outside and inside of the cylinder respectively, then $M-M'$ will be the force that tends to contract the cylinder. If P is the air pressure introduced, then

$$M-M'-P$$

As $M-M'$ is constantly increasing, the pressure must be increased in the same proportion, if the cylinder is to be held to a uniform diameter.

There are several factors affecting the pressure, some tending to increase the pressure and some having a reducing effect. Lubbers devised a means of overcoming the trouble, sufficiently to meet the requirements of practical operations, which was to introduce an excess of blowing air and then allow a portion of it to escape through a vent hole.

REGULATING DRAWING SPEED

It was not long until the practice of gathering a ball of glass on the blow pipe was abandoned, and the pipe was lowered directly into the glass. When this was done it was found necessary to vary the speeds. Three speeds were used at first, one to form the neck, one for the cap and one for the body of the cylinder. This was later changed so as to use one speed for the neck and cap, one for the body of the cylinder and one to thin the lower end for shearing off.

It was also observed that the glass in the pot was gradually cooling as the drawing progressed, and therefore the walls of the cylinder were gradually thickening. The speed was therefore gradually increased, the increase being adjusted so as to compensate for the increasing viscosity of the cooling

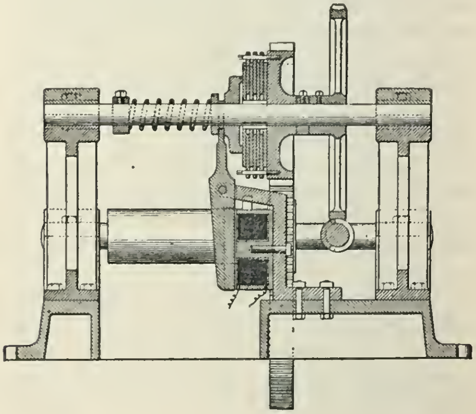


FIG. 4.

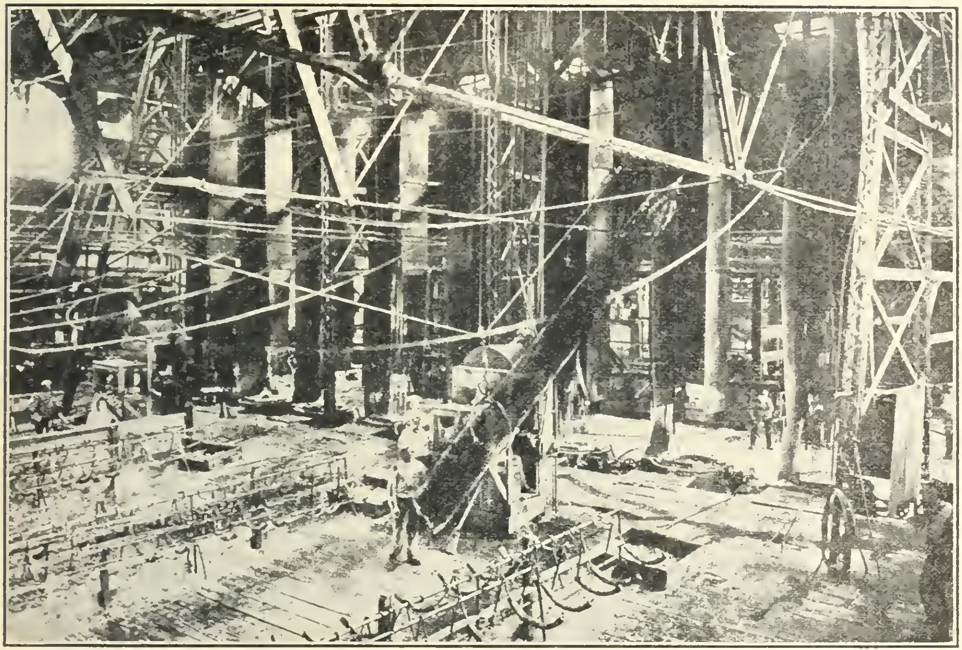


FIG. 5.

glass, and thus produce a cylinder of even thickness longitudinally.

Two factors control the thickness of the glass in a cylinder, first, the viscosity of the glass—governed by its temperature, and second, the speed of draw. The same thickness may be drawn from glass of different temperatures, if the speed is regulated to compensate for the variations in viscosity. The problem is, however, complicated by the necessity of drawing glass of even thickness around the entire circumference, by the necessity of preventing excessive cooling strains, and of avoiding loss of time as far as possible. In early operations there was considerable difficulty in keeping the thickness of the product up to standard single strength, and there was quite a little loss due to the production of thin glass that could not be marketed. As the machine became perfected, it was not only possible to produce good, standard single strength, but also double strength and heavier grades up to three-sixteenth inch.

Several types of mechanism for raising the cross-head were tried, the one finally adopted being a motor driven geared hoist. This was provided with a friction clutch held in position by a strong spring. An electro magnet was used to release the clutch so that the cross-head could be lowered after the draw. This type of hoist is shown in Fig. 4.

FINAL HANDLING OF THE CYLINDERS

In the early Lubbers' apparatus there was a cord attached to the blowpipe during the draw, this cord passing through an overhead pully. After the draw was completed the pipe, with the cylinder attached, was detached from the cross-head by pulling this cord and lowering while still attached to the cord, to a horizontal position. The hoist with the magnetic clutch control made it possible to lower the cylinder by simply swinging out the lower end, using curved supports, "taking down hooks," to support it, and slowly lowering the cross-head at the same time on which the pipe and cylinder still remained suspended. This was hard and dangerous work for the men who handled the taking down hooks, and considerable experimenting was done with a view to providing apparatus for taking down the cylinders mechanically. The device that was finally adopted and which is now in general use is seen in Fig. 5.

This brief outline gives very inadequate idea of the immense amount of study and research expended on the various problems involved, and the numerous alterations in the mechanical details that were found to be necessary while the machine was being developed and conditions of machine operation determined. It was a tedious and difficult task, but one by one the difficulties were overcome until finally machine operation attained such a degree of success as to dominate the window glass business of this country and has reached out to new fields abroad.

Machine operation has immensely increased the output per tank and output per man in the blowing room. The machine blower, operating four machines, displaces on an average eight hand blowers, and not only this, he produces a great deal more glass than the eight hand blowers could possibly make. The whole labor force of a present day machine blowing room is less than half the labor force in the blowing room of a hand operated plant. Under hand operation a tank furnace was rated as so many blowers' capacity. A 48-blower tank, for instance, was a tank designed to melt sufficient glass to supply 16 blowers on each of the three working shifts; it was estimated that if the blowers all worked to the limit of capacity fixed by union rules it was as much glass as the tank would melt. The same tanks after being remodeled—not enlarged, or only slightly enlarged—have yielded an output in finished glass that has shattered all records in hand blown operation, and completely upset all previous ideas of tank capacity.

Not only in point of capacity, but as regards quality of product as well, has the machine scored a remarkable success. In the early operations a great deal of doubt was felt as to whether machine glass would ever equal hand blown glass in quality. Now the standard is set by machine made glass, which is recognized as the highest and most uniform quality produced in this country or abroad.

A SPECIFIC GRAVITY BALANCE FOR GASES

This is the subject of technologic paper 89 of the Bureau of Standards. The need for an accurate method of determining gas densities has been especially urgent in the natural gas industry, where the measurement of gas by means of orifice meters requires a knowledge of the density of the gas. An investigation by this bureau of the effusion type of apparatus, which has been generally used for this purpose, but which has proven unreliable in practice, has shown the need of more precise methods. The apparatus described in this publication provides a quick, accurate means of determining gas density. The balance beam is supported on two needle points which give high sensibility. The needles are easily adjustable and in contrast with the metal or quartz knife edge usually used can be obtained almost anywhere, are inexpensive, and can be replaced as often as necessary. The success obtained in the use of this apparatus is mainly due to the high sensibility afforded by this means of support.

GAS AND GASOLINE IN SEWER EXPLOSIONS

In the city of New Haven, Conn., as far back as 1886, there was an explosion of a 60-inch round sewer. The force of the explosion was so great that the arch was thrown off completely for a distance of about 100 feet. (Fig. 1.) Nobody seems to know how that explosion occurred, and luckily nobody was hurt.

Some eight years later, in the same old town, a 54-inch round brick sewer was undergoing the process of cleaning out. Four men were busy on the job, when suddenly an explosion occurred in the sewer. Luckily, the men escaped death, but two of them were disabled for six months or more. It was decided that the explosion appeared to be from illuminating gas in the sewer.

And as recently as 1913 New Haven once more experienced a sewer explosion. This time it was in a 42-inch, egg-shaped, brick sewer. Like the last mentioned explosion in the 54-inch sewer, this one was being cleaned when the explosion occurred. It did not kill the men. They were just burned about their hands and faces.

People were inclined to blame illuminating gas again for the mishap, but investigation showed that a factory nearby allowed gasoline drips to enter the sewer. When this

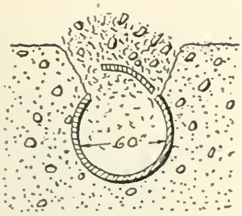


FIG. 1.

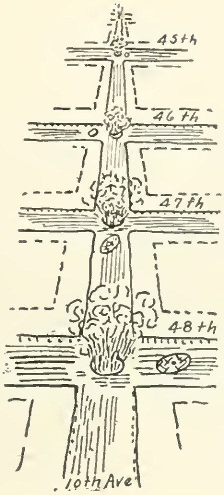


FIG. 3

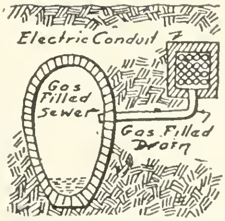


FIG. 4

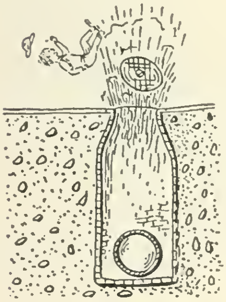


FIG. 2

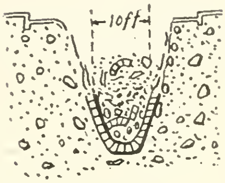


FIG. 5

TYPICAL SEWER EXPLOSIONS.

fact was unearthed, a workman remembered having detected the odor of gasoline when he first entered the manhole.

If gasoline was really the cause of that explosion, and if it came from the manufacturing plant, whose gasoline drippage was very small, the incident may be taken as very good proof that a very small quantity of gasoline in a sewer can do a great amount of damage. It also goes to show how necessary it is for garages, both public and private, to have proper gasoline trap floor drains, that will positively prevent gasoline from getting into sewers.

In Philadelphia, an explosion occurred in a sewer which killed several men. Part of the report of the chief engineer of the Bureau of Sewers is as follows: "A suspicious smell was noticed upon opening a sewer manhole, and a blazing paper thrown in resulted in a column of flame about 40 feet in height, due to gasoline from a nearby factory." (See Fig. 2.).

But when it comes to doing anything on a big scale, we must look to New York City. There they had a rather spectacular explosion in 1909. It affected not one block or even two, but the whole territory within half a mile square.

It is recorded that in this particular case in the sewer at 48th street and 10th avenue. a violent explosion was heard at 4:40 P. M. A few seconds later, another explosion further south on 10th avenue got the people on edge. Then a regular bombardment of big guns appeared to be on. Explosion after explosion ran along 10th avenue for half a mile, and up the cross streets. The enemy batteries were underground, for with every explosion, flames burst from manholes and dense clouds of black smoke filled the streets. (See Fig. 3). The telltale black smoke was the convincing exhibit that sealed the verdict against gasoline in New York sewers for evermore.

Although the ban was put on gasoline vapor, there are other substances that can explode in sewers and keep folks busy. Illuminating gas, for instance, from leaky street mains sneaks into sewers like the small boy under a circus tent. (See Fig. 4.)

Even the electric conduits under the streets are sources of danger when inflammable gas of any kind exists in a street sewer. Just two years ago a case of this kind occurred near 42nd street. The conduit was drained into the sewer. It is believed that an explosive mixture was in the conduit as well as in the sewer and in the cross connecting drain between them, and that an electric spark ignited the mixture in the conduit, which flashed back through the drain and ignited the inflammable gas of the sewer.

But Pittsburgh wins the pennant, when it comes down to real damage and cussedness in sewer explosions. For in November, 1913, a disastrous sewer explosion which occurred there, disturbed the usual steadfast equanimity of that great manufacturing town. A whopper of a main trunk combined sewer, some ten feet in diameter, was burst asunder for a distance of 5,000 feet. (See Fig. 5.) Manholes were destroyed, windows were smashed and streets caved in. This explosion cost the city some $300,000 to repair. The costs of suits for damage may run the cost up to half a million.—Plumbers' Trade Journal.

CITY GAS DISTRIBUTION SYSTEMS

Distribution systems may be divided into three classes: Those operated under low pressure, those under medium pressure and those under high pressure. As a distinction between the classes some defined pressure range must be given each. Systems carrying pressures up to one pound (27 in. water) may be classed as low pressure systems, those carrying from one to five pounds as medium and those carrying above five pounds high pressure systems. A number of combinations of the above systems are used in various cities, most of which have been evolved as a modification of some existing system.

In the early history of the gas industry all distribution was done under low pressure, but as the business developed the need of greater carrying capacity in the existing mains or larger mains became apparent, and as the former was possible by increasing pressures, the result was an evolution in distributing systems which has resulted in the high pressures so generally used today, and which has made possible the distribution of gas to small communities from a centrally located plant which otherwise would never have been supplied.

The benefits derived from this evolution in gas pressure have not been confined to the new customers obtained by supplying isolated districts. Better service has resulted from the efficient control of pressures, which has resulted in revenue from new customers and increased revenue from old ones, while installation costs have been reduced through the use of smaller and cheaper wrought iron mains instead of the large and costly cast iron pipes used in low pressure distribution.

The following is a list of the various distribution systems in use today:

1. Distributing with low pressure from a holder or holders, located at the plant.
2. Distributing with low pressure from both station and district holders.
3. Distributing with low pressures, but supplying district holders through medium or high pressure lines.
4. Distributing with low pressure, the low pressure mains being reinforced through district governors from a belt line carrying medium pressure.
5. Distributing with low pressure, the low pressure mains being reinformed through district governors from a belt line carrying high pressure.
6. Combination pressure being used. The pressure being raised at the plant to suit requirements in outlying districts, individual regulators being used on the services adjacent to the plant and along feeder mains where required.
7. Medium high pressure carried on all mains with individual regulators on each service.
8. High pressure carried on all mains with individual high pressure regulators on each service.

The above list shows plainly the evolution through which distribution systems have passed. Each system has its special advantages provided the system is adapted to the particular city in which it is used. There can be no fixed rule as to which system is the best to apply to all cities, but, due to the flexibility and low first cost, No. 6 consummated in No. 7 is adaptable in most cases.—*Gas Age.*

WHERE A COMPRESSED AIR MISSIONARY IS NEEDED

The two air pressure records here reproduced were exhibited at a recent meeting of the Lancashire Branch of the National (British) Association of Colliery Managers They were shown for the purpose of telling the story of the correcting of the fluctations of air pressure which occurred at Chapel Col-

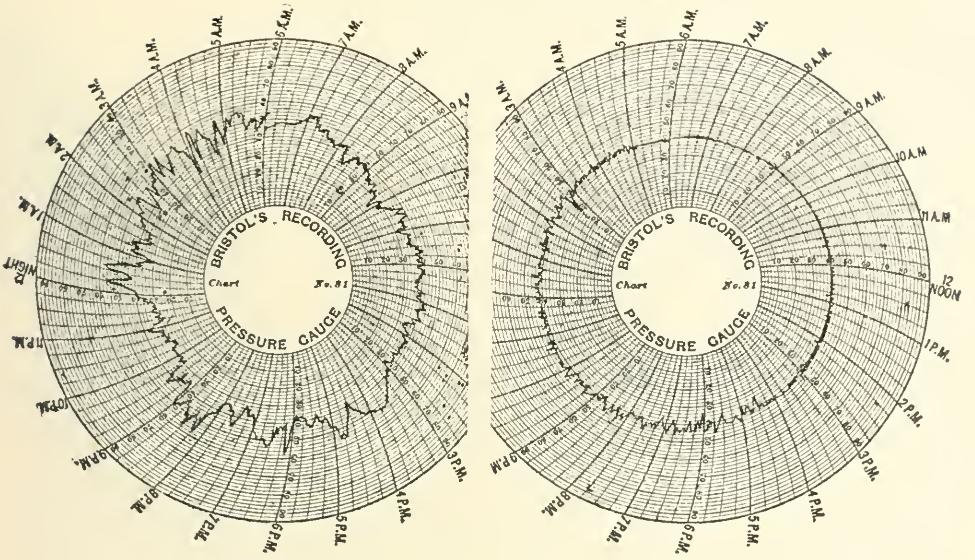


CHART A. CHART B.

SHOWING THE LOW PRESSURE USED.

liery, chart A being before and chart B after the change. As to what was actually done in the matter we are told as follows: "In the absence of automatic control of the pressure of the compressor, control of the pressure by the engineman was arranged by leading a chain gear from the throttle valve of the compressor steam engine to a convenient position. The engineman also noted each hour from the revolution counter the number of revolutions made by the compressor. A time table for the several coal cutters was arranged in diagram form, with a view to distributing the demand for air as uniformly as possible throughout the cutting shifts, and on the same diagram the average number of revolutions made by the compressor in each hour was plotted. Not an ideal or very satisfactory arrangement at the best. There should have been an entirely automatic control and adjustment of the air pressure, and there should have been a sufficient air supply for all the coal cutters that might at any time require it to operate to the best advantage independently of that.

ABSURDLY LOW PRESSURE USED

These records are reproduced here, however, more for the purpose of calling attention to the absurdly low pressure apparently regarded as satisfactory. It will be noted in chart B that the pressure is maintained at 40 lb. gage, never being allowed to rise above that. This, it will be understood, was in the compressor house, while at the machines when in operation the pressure could not have been above 35 lb. It must be said that management and men who can potter along with such pressures as that do not know anything about what compressed air machines will do, and they should have somebody to show them what successful practice is.

ELECTROLYTIC OXYGEN DANGEROUS

There occurred in California last summer, within three days of each other, three fatal explosions of oxygen tanks used in oxyacetylene metal cutting and welding. Seven men were killed and five more seriously injured. An investigation which immediately followed under the direction of John R. Brownell, Superintendent of the Department of Safety, Industrial Accident Commission, brought out the fact that the explosions were due to the presence of hydrogen in the tanks commingled with the oxygen in sufficient proportion to form highly explosive mixtures. An account of the investigation and its results is contained in the first issue of California Safety News, the essential portion of which is here presented:

All three explosions occurred in tanks of oxygen supplied by the same manufacturer, who had used what is known as the "electrolytic" method in obtaining oxygen. Each explosion occurred immediately after a new tank of oxygen had been put in use, and all were found to be due to the presence of an explosive mixture of gases in the oxygen tanks. The pressure in the three tanks varied from 350 to 2,200 lb. per square inch. Five other tanks were recalled from customers to whom they had been shipped by the same manufacturer. The contents of these tanks were carefully analyzed, with the following results:

Tank Number	Per cent O	Per cent H	Per cent CH	Per cent N
X10980......	99.5	0.6	0.1	0.4
X11063......	54.25	42.5	0.53	3.18
X13553......	28.3	69.0	0.30	2.43
X 9233......	42.3	52.55	0.6	4.6
X10789......	41.05	55.0	0.48	2.98

The investigation developed the fact that while these tanks were being filled it was necessary to make repairs to one of the electrolytic cells at the company's plant, and one of the repairmen accidentally interchanged the feedline connections of a set of twenty cells, causing the poles to be reversed, and resulting in the mixture of hydrogen with oxygen which went to the container from which the tanks that later exploded were filled.

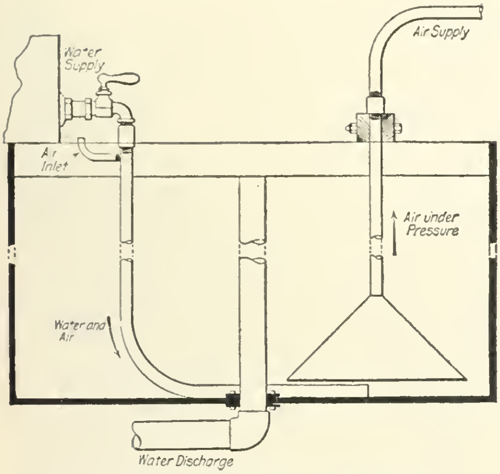
COMMISSIONER'S RECOMMENDATIONS.

The commission pointed out that *oxygen manufactured by the liquid-air process does not contain hydrogen.* If oxygen manufactured by other processes is used it should be ascertained that the hydrogen content be less than 2 per cent. The user of oxygen made by the electrolytic process, the commission recommends, should satisfy himself that the following precautions are taken by the manufacturer:

1. Every electrolytic oxygen plant should be equipped with a system of purifiers, the purpose being to eliminate, as far as practicable, the presence of hydrogen in oxygen.
2. All electrical connections should be so constructed that they will be non-interchangeable.
3. A device should be installed for the purpose of preventing reversal of current between the generator and the cell connections.
4. High-pressure gages should have safety relief features.
5. Tests of both hydrogen and oxygen should be made every two hours where the capacity of the system exceeds 100 cu. ft. per hour. This test should be run alternately with gas obtained from the gas holder and from the line between the cells and the gas holder. (The purpose of the test is to check up the gas being shipped out and also the gas which is going into the gas holder.)
6. Each plant should have gas holders of sufficient size to take the capacity of the plant for at least two hours.
7. All hydrogen tanks should be provided with fittings which are non-interchangeable with those of the oxygen tanks. It is recommended that the former be left-hand fittings and the latter right-hand fittings.
8. Each cell should be equipped with a "relief" feature, the purpose being to safeguard against back pressure.
9. A complete record of each test, as well as any important features connected with the process, should be kept and turned over to the management or authorities competent to examine it.
10. A competent operator should have supervision of the plant. He should be thoroughly familiar with the making of tests and the reconstruction of cells, and should be sufficiently acquainted with electricity and its application to electrolytic oxygen manufacturing competently to take care of any disturbances.

A LABORATORY HYDRAULIC AIR COMPRESSOR

The cut here reproduced from a recent issue of Engineering and Mining Journal, contributed by Mr. A. W. Allen, shows an interesting adaptation for laboratory use of the principle of the Taylor hydraulic air compressor, which, as our readers know, has been successfully employed for the compression of large volumes of air delivered at pressures up to 100 lb. Water flows freely from the faucet up at the left and as it drops down the pipe it carries more or less air entrained with it. The air thus mixed with the water might as well be admitted by a number of little holes drilled in the pipe coupling immediately below the faucet instead of by the air inlet pipe shown in



LABORATORY LOW PRESSURE COMPRESSOR.

the sketch. The height of the faucet above the surface of the water in the tank should be greater than here indicated or the flow will be slow and the air delivery very small. The water, with the air it carries, is discharged from the open end of the pipe under the middle of the suspended conical hood. The air accumulates in this hood and is carried off under pressure by the ascending pipe. The accumulation of water will overflow at the surface of the water in the tank and escape down the discharge pipe. The pressure of the air delivered will be determined or limited by the height of the water surface above the top of the hood, and of course cannot be great. It would be sufficient for blowing purposes but of course not for operating pneumatic tools. The water may be used over and over by pumping.

IMPROVED AIR BLAST FOR HARDENING TOOLS

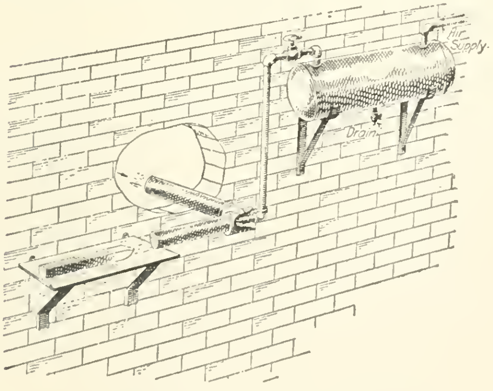
BY J. V. ARTHUR

Have you walked by the tool dresser's fire, day after day, and heard the roar of the blast of compressed air escaping where it is used for chilling the cutting edges of the lathe and planer tools? And have you wondered whether anything could help relieve this tax on an already overloaded compressed-air plant? The tool dresser will tell you that he needs lots of air, because that being used is too hot for good hardening. Incidentally he will probably complain that the air carries so much moisture that the water is causing the steel of the tools to check, and out will come a display of several tools that were "perfectly good" before they were put before the air blast.

Those were a few of the conditions that the air installation, shown in the accompanying figure, was designed to meet. In this particular case the air blast was located immediately above the steam-heating coils, so there was a probability that the temperature of the surrounding air was relatively very much higher than that of the rest of the room. The nozzle was at that time arranged to blow into the open end of a piece of 3-in. pipe about 12 in. long, the air coming out of the other end upon the tools in a diffused condition, so that it would cover a larger portion of the work placed before it. At the same time the air blowing into the open end of that pipe created a suction that carried a large volume of the outside air through the pipe with it, so that really the volume of air delivered for cooling the tools was greatly increased.

To overcome the difficulties due to the hot inside air, an elbow was placed on the 3-in. pipe with an extension through the outside well to draw in cool air. Then using a side-outlet elbow, the air nozzle was drawn to a point and extended in about 2 in. This arrangement formed an injector, which delivered several times the amount of air to the tools that the system would otherwise have permitted.

The problem of the disposal of the excess moisture in the air was met by the installation



AIR BLAST FOR TOOL HARDENING.

of the small tank in the pipe line close to the air-blast connections. This tank, about 10 in. in diameter by 20 in. long, was made of galvanized sheet steel with welded seams and was fitted with a small drain cock at the bottom. The drain cock was for the purpose of drawing off any water that might condense in the tank.

Since this installation was made, the shop has been very successful with the tools that have been redressed. Perhaps this has been due in part to the greater interest taken in seeing that the work should come as near right as possible, but it also seems probable that the elimination of a large part of the trouble caused by the old air blast has had considerable to do with the better results that have been obtained since the installation of the new system.—American Machinist.

PNEUMATIC CHISELS FOR STEEL BILLETS*

In spite of the exercise of suitable precautions, such as proper deoxidation of the metal in the open hearth furnace and careful rolling practice in the blooming mill, billets and other steel materials often contain cracks and seams. The only practical method of removing these defects is to employ the chipping hammer. This is done so almost universally that it is surprising that more attention is not given to the cost of the work. As would be suspected, the cost is variable from plant to plant, the following being cogent factors in its determination: (1) cost of labor; (2) cost of moving and shifting steel into position for chipping; (3) cost of inspection; (4) cost of air hammers including depreciation; (5) cost of chipping-chisels; and (6) cost of grinding chisels.

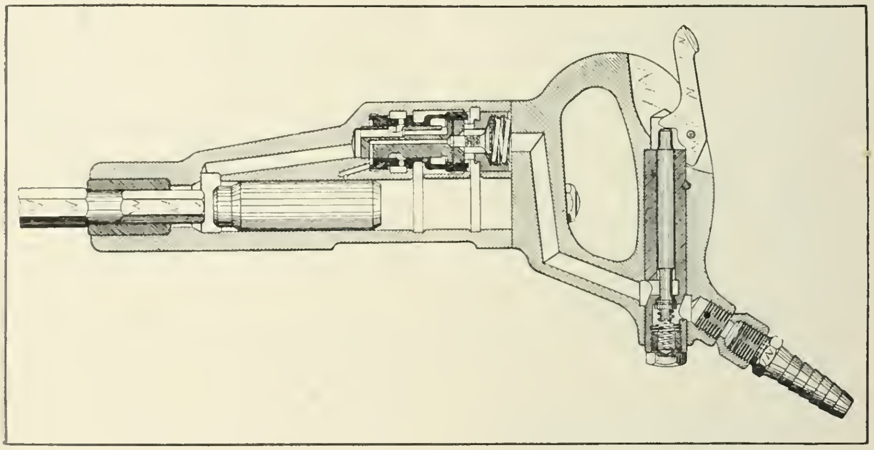


FIG. 1—LONGITUDINAL SECTION THROUGH CHIPPING HAMMER.

An investigation of chipping was recently carried out in a large steel plant in the central west, and the work resulted in some new departures in practice as well as in a reduction in the cost. The summation of the results of the experiments and the tests is embodied in what follows.

Unskilled labor of the cheapest type obtainable proves to be the best suited for this work. The job of chipping has few attractive features and is highly unpopular with the more intelligent workers of the unskilled labor class. On account of the nature of the work, it is a difficult matter to keep the ranks filled. The constant jar of the hammer is hard on the men and the stooped-over position necessitated by the work is tedious, so that the men, as a rule, are either continually quitting or asking to be transferred to another department. There appears to be no way by which the method of chipping may be altered and still accomplish the desired results. Some slab-yard foremen are of the opinion that the problem cannot be solved. That the cost of chipping can be reduced, however, is borne out by the results of tests.

As already stated, the job is a hard one,

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*Condensed from Iron Trade Review.

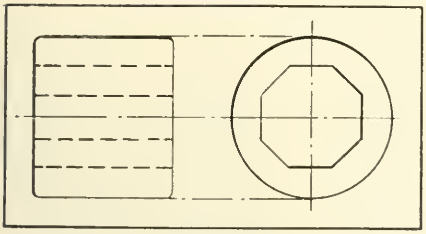


FIG. 2—OLD TYPE OF TWO-PIECE NOZZLE USED IN AIR-HAMMER.

and chippers will avail themselves of the slightest excuse to stop work. Investigation shows that most of the time lost arises from chisel breakage, or, in general, defective chisels. The labor cost is a more or less fixed item, but will vary with the amount of work to be done and the efficiency of the chipping gang. Fig. 1 shows a longitudinal section through a hammer brought out by the Ingersoll-Rand Co., New York, for heavy chipping purposes. This type of hammer was used at the plant under discussion and gave satisfactory service. There has since been a slight change of design in the nozzle which takes the chisel shank, as illustrated in Figs. 2 and 3. Fig. 2 illustrates the nozzle for holding octagonal shank chisels, and Fig. 3 shows the nozzle for holding the conical shank chisels. The latter is more satisfactory than the former. The air consumption per hammer is 19 cubic feet per minute. The cost of air varies from plant to plant, depending on the type of air-compressor and the cost of generating steam.

CARE OF HAMMERS

In order to keep air-hammers in good working condition, they should be properly cleaned and oiled at frequent intervals. For lubrication, a small amount of clean, light machine oil should be poured into the inlet of the handle; when the tool is being used constantly, this should be done every two or three hours. A thick oil should not be used as it causes the moving parts to work sluggishly. For cleaning, the hammer should be taken apart at least once a week, and the parts washed in kerosene.

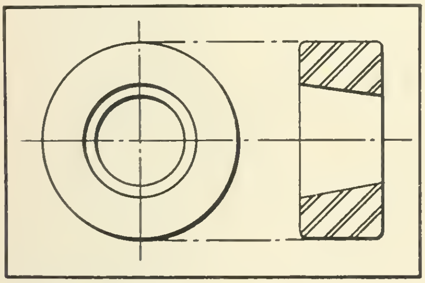


FIG. 3—NEW TYPE OF TWO-PIECE NOZZLE USED IN AIR-HAMMER.

THE CHISELS

The cost of keeping chippers supplied with good chisels is high at best and will be higher unless care is exercised in their treatment. Any investigation of chipping cost with a view to reducing it inevitably leads to a consideration of the chisel itself. The first cost of chipping chisels varies within wide limits according to whether alloy steel or straight carbon steel is employed, and to whether conically tapering or octagonal shanks are used.

A typical steel for chipping chisels at one plant analyzed as follows: Carbon, 0.70 to 0.90 per cent.; sulphur, 0.035 per cent.; phosphorus, 0.015 per cent.; and manganese, 0.20 per cent.

Each chipper needs from six to 12 chisels on hand at all times. Regardless of the shape of the shank, it is worthless if it does not fit the hammer nozzle. Where chisels are used in large quantities, as where 50 or more chippers are at work, it is found economical to have the shanks machined outside at contract prices. Forging, shaping and heat treatment are best performed in the plant, because of the necessity for having a repair man on chisels most of the time. The forging and shaping of the cutting end may be done by a tool blacksmith, but heat treatment should be entrusted to more capable hands and executed under close pyrometric control.

Chipping chisels are short lived because of the severe service requirements and because of the rough treatment they receive at the hands of chippers. To stand up successfully under this hard usage, the steel should be put in the best possible condition. No rule-of-thumb heat treatment is effective, and the results of tests conducted unmistakably demonstrate the superiority of chisels treated under pyrometric control. Experience has shown that straight 0.70 to 0.90 per cent. carbon steel is well adapted for chipping chisels. The chisel point should be of such hardness that it will do the work without breaking off by reason of excessive hardness or yet bend or "dub" over on account of softness. The shank of the chisel, which fits into the nozzle of the air hammer, must also be treated to stand up under the work. It cannot be so hard as to break off through the shock of pounding or yet so soft as to flow under the repeated blows and accordingly become sufficiently wedged to break the nozzle.

HEAT TREATMENT

A number of experiments were carried out at the plant already mentioned for the purpose of developing a judicious rationale of heat treatment. Previous to the solution of the problem, the chisels were dressed up by the tool blacksmith and given a so-called heat treatment. The latter was conducted by ill-advised, haphazard methods. Strange results followed, as would be expected. One chisel would perform excellent work, while the next dozen or so would be worthless, either so hard as to break off or so soft as to bend over. On an average, 300 chisels were being dressed and heat treated daily.

The experiments for a time showed only negative results, as is usually the case, but a suitable treatment was finally devised. Chisels of 0.80 per cent. carbon steel were heated to 735 degrees Cent. (1,355 F.), or just through the critical range, in a gas fired muffle furnace having uniform temperature. Fifty chisels were charged at once and allowed to soak until a pyrometer rod in the middle of the pile showed 735 degrees Cent. When up to heat, the chisels were quenched by immersing the point about an inch and a half in water. The strains induced by this drastic quenching were relieved, and the resultant hardness mitigated somewhat, by drawing the chisels at 250 degrees Cent. (482 F.) in a bath of high-flash quenching oil. This drawing temperature was discovered by trial of the chisels. Lead baths for heating the chisels before the quenching are preferable.

The foregoing treatment proved rapid and effective; a uniformity of product was secured not possible by any haphazard process. The consumption of chisels was cut down considerably and after the system was placed in working order only 50 chisels, on an average, required heating and dressing per day. The improved method showed a saving of at least $3.90 per day, and if the depreciation charges were added a larger saving would be apparent.

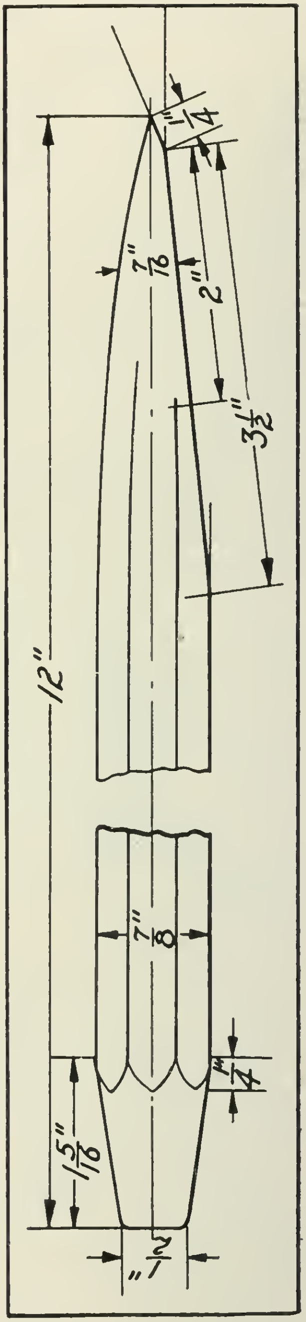


FIG. 4—HALF-ROUND CHISEL OF CORRECT DESIGN.

GRINDING

A great deal of trouble with chisels, as well as with other tools, arises from ill-advised grinding methods. Heat treatment has been emphasized as an important operation; nevertheless, correct grinding is fully as essential. The damage caused by improper grinding comes from heating the steel and thus undoing the preceding work. The steel is injured by "drawing the temper," which really means that sorbite and pearlite are formed as the critical range is approached. Checking and surface cracks also are formed by the sudden rise in temperature of the thin outer skin of the steel. For hard carbon chisels, grinding wheels of fine grain are recommended. The pressure during grinding should be light, so that the steel is not blued or burned. Strictly speaking, chipping chisels should be ground by a competent tool room man. The economy of such a course over having every chipper grind his own chisels is apparent.

Another cause of the short life of chisels is the unnecessary abuse on the part of the chippers. This element is always present whenever new men are broken in for the job. The chief trouble lies in the fact that most chippers seem bent on ramming the tool down into the steel, to force it to bite, and then bending it over suddenly. The result is that the chisel either breaks off or bends over. Such abuse can be largely overcome by closer supervision over inexperienced men.

DESIGN OF CHISELS

Some of the trouble with chipping chisels is due to faulty design. Several different shapes were tried out in the recently conducted tests with more or less indifferent results. A half-round chisel proved to be the most suitable for the purpose, and the one shown in Fig. 4 was adopted as standard. It should be observed that there is a slight kink or bulge in the curved surface of the back. This throws the cutting edge on a line with the axis, which is both theoretically and practically correct.

COMMERCIAL METERING OF AIR, GAS AND STEAM

In a paper read recently before the Institution of Civil Engineers, (England) Mr. John Lawrence Hodgson discussed the various bases which are suitable for the measurement of compressed air supplied in bulk, and emphasized the desirability of measuring in energy rather than in weight or volume units. The basis of measurement adopted by the Victoria Falls and Transvaal Power Company and by the Rand Mines, Limited, was the quantity of air which would be compressed from mean atmospheric pressure and temperature on the Rand to the pressure of delivery by the expenditure of the energy represented by 1-kw.-hour in an isothermal compression process of the same overall efficiency as that which obtained between the indicated power in the steam cylinders and the air delivered in the case of certain specified compressors then in use upon the Rand; it being understood that these compressors should be put in first-class order for the purpose of the test, and run under normal conditions as regards speed and pressure.

Descriptions were given of the meters and over-load devices designed by the author for use in connection with the Victoria Falls and Transvaal Power Company's air-supply scheme on the Witwatersrand. Two types of meter were used in connection with this scheme; in that supplied to the Power Company a Venturi tube was used, and in that supplied to the consumers a weighted gate placed in the air-way. The more interesting parts of these meters were described; including (1) the arrangements whereby the various factors upon which the energy required to compress the air delivered at each point of supply depends are measured and combined so as to give a counter and diagram record of the energy passing; (2) the bell, which is sensitive to a Venturi head of less than 1-10,000th lb. per sq. in., and which will measure Venturi heads up to 0.85 lb. per sq. in.; (3) the pressure diaphragms, by means of which a powerful movement is obtained from a small change in the pressure; and (4) the air-driven centrifugal escapement by means of which the integrating gear is accurately timed.

Two types of overload device were then described; the one cutting off the flow if the maximum discharge contracted for is exceeded; the other throttling the discharge when necessary, to limit it to the maximum contracted for. These overload devices are so arranged that they can readily be set to cut off or to regulate (as the case may be) at various maximum flows within their range.

The author described the testing plant

which was specially built for calibrating these meters by Messrs. Fraser & Chalmers, and now re-erected at Ferreira Deep on the Witwatersrand, forming the standard air-testing plant for South Africa. Details were given of the large displacement meter which forms part of this plant, capable of passing 1,200 lbs. weight of air per minute, and of the precision manometer by means of which differential pressures can be measured over a large range to within 1-1,000 in. head of oil.

The author went on to discuss the relation between liquid and gaseous discharges through the same nozzle, and showed, for various typical nozzles and orifices, how the gaseous discharge can, under certain conditions, be calculated if the liquid discharge is known. A table was included showing how the economy in the power required for testing meters or wind-resistance models diminishes with the density of the fluid used. The importance of designing the discharge nozzles of "fair shape," if the theoretical discharge formulas are to be used to obtain the discharge, was emphasized. Work on square-edged orifices was carried out by the author in order to obtain an easily reproducible standard of air measurement, but he indicates his preference for the use of round-edged orifices for commercial work on account of their smaller liability to be damaged by erosion or careless handling.

In discussing the difficulties met with in measuring pulsating flows by means of nozzles and orifices, the author submitted tables showing for three typical wave-forms of various amplitudes, and for two different laws of damping, the nature and the approximate amount of the error likely to occur in the measurement.

Other meters described were:—(1) A meter by means of which pulsating flows of any wave-form and amplitude may be accurately measured. (2) A meter designed by the author for general mining work, simple in construction and easily handled, installed and maintained. It can be arranged to register in weight, volume, or energy units, as required. It will measure such pulsating flows as are met with in practice with sufficient accuracy, and it corrects automatically for variations in pressure. (3) A steam-metering instrument designed by the author. (4) A gas-meter which has been successfully used for the metering of large volumes of gas. It will measure down to one-twelfth of full load, and, unlike all other gaseous meters which depend upon a differential pressure measurement, the registration of this meter is independent of the density of the gas passing.

DRILL SHARPENERS FOR SMALL STEELS

The half tones on these pages give us two different views of a drill sharpener which has been specially designed to meet the requirements of the small mine quarry or contract. It is known as the Leyner Jacksteel Sharpener, and is a small edition, with modifications, of the standard No. 5 Leyner sharpener.

The new machine is designed to handle the small sizes of steel, such as used with jackhamers, stopehamers, plug drills of various kinds and the like. The manufacturer limits its capacity as follows: Steel sizes: 1 1-8 maximum diameter round, cruciform, and light section twisted or banded steel; 1-in. maximum diameter hexagon or octagon steel; 7-8-in. maximum diameter square steel.

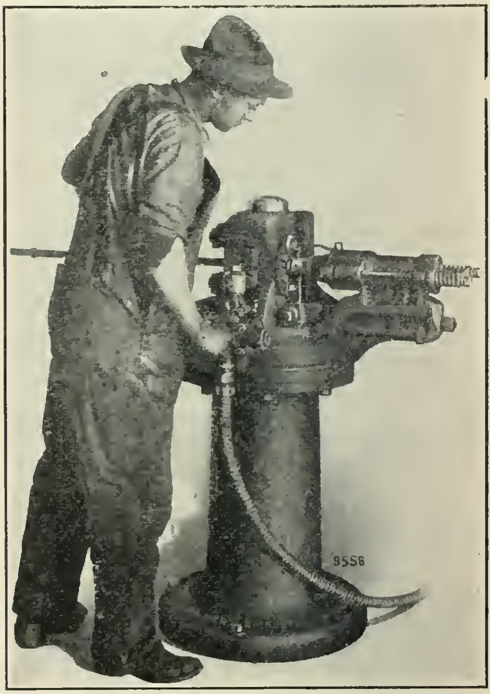


FIG. I.

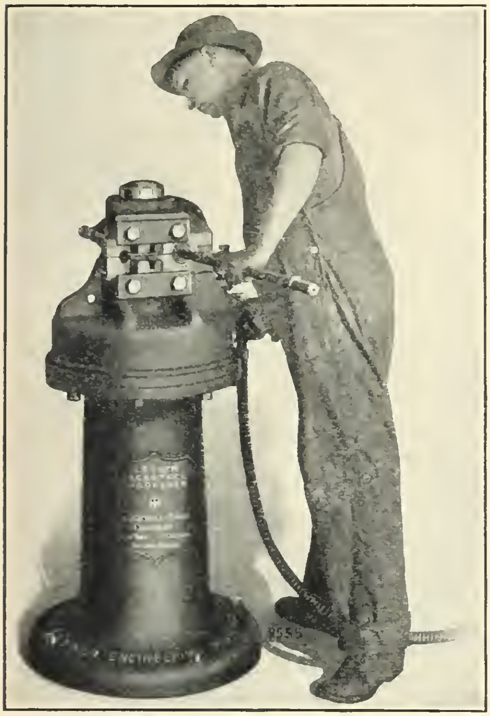


FIG. 2.

Bit sizes: 2-in. maximum diameter 4, 5, 6, point, Z, X and single or double chisel bits of standard 14-degree taper; 1 7-8-in. maximum diameter "Carr" or bits of other than 14-degree taper. Shanks also can be made on the smaller sizes of steel by the usual Leyner method.

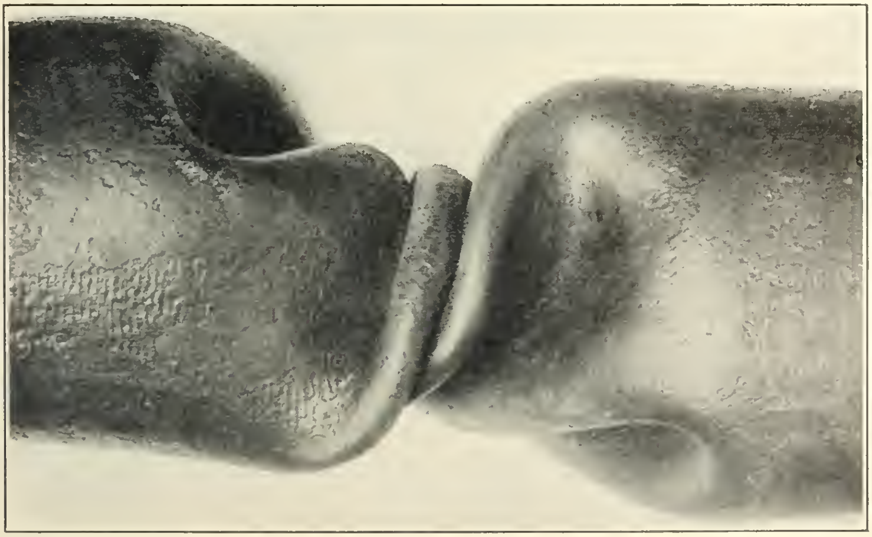
An unusual feature is the employment of a single piston rod on the clamping piston. This allows the Leyner die and dollying hammer to be so located as to operate immediately under the eye of the operator. This advantage of complete visibility of the entire operation is stated to be of prime importance in securing the best possible grade of work.

An entirely enclosing die is employed, as with the large Leyner sharpener, in which the metal of the bit is thoroughly compacted by the dollying hammer. The completion of the sharpening operation within the die effects the same absolute correctness of gage and exact duplication of bits of any gage. A single lever (under the operator's hand in Fig 1) controls both clamping and dollying. This, it is claimed, conserves the muscular effort as well as the time of the operator.

The machine weighs 925 lb. No special foundation is required. Made by Ingersoll-Rand Company.

A TWIST IN NATIONAL TUBE

The excellent photo here reproduced shows a mechanical curiosity of the present day which would have been an impossibility not so very long ago. It is not rubber, molasses candy, soap, putty or any such yielding substance, but as far from it as possible. It is a piece of 8 in. National Line Pipe which



has been subjected to a torsional stress of 713,000 inch pounds. This pipe is about 3-8 in. thick and weighs 29 lb. per foot. The specimen shows not the slightest sign of cracking or tearing, which indicates the wonderful properties of the metal.

THERMALINE

Thermaline is a gas, the discovery of which was recently announced from Zurich, Switzerland. It is used for welding and cutting in the same manner as acetylene is used with oxygen. It is produced by the decomposition of calcium carbide with water and is enriched or compounded with the heated vapors of crude oil. There are several claims made for it. It is heavier than air, specific gravity 1.1, and it is said it can be used at a lower pressure than the other gases. It is not explosive when liquefied, and its explosive range is narrow; the explosive ratio is from 12 per cent. to 30 per cent. air. It can be liquefied at a pressure slightly over 1,400 pounds and at the ordinary atmospheric temperature. An excess of oxygen is not required in the welding flame, so that there need not be any reduction of the carbon in the iron or steel which is being welded, thus producing a soft weld. It is generated automatically in a portable apparatus as needed and delivered to the torch at 15 pounds pressure. The special feature in its production is the use of cartridges of material, consisting of alternate layers of calcium carbide and sawdust soaked in oil. It is necessary to wash, purify and cool the gas.

THE BEGINNING OF MECHANICAL REFRIGERATION

The original air refrigerating machine was brought out in 1845 by Dr. Gorrie of New Orleans, who with Dr. Cullen felt a special need of artificial refrigeration in the aid of his profession. This mechanism had a cylinder in which the air was first compressed. It was passed from this cylinder to a chamber cooled by running water where a pressure of fifteen pounds per square inch above that of the atmosphere was maintained. The air was already cooled partly during compression by the injection of water, the cooling chamber receiving in reality a mixture of air and water. This on passing to another cylinder was expanded down to something like atmospheric pressure. While expanding it was mixed with brine injected into the cylinder, the low temperature of the expanding air communicating itself to the brine. The air on leaving this cylinder was allowed to escape to the atmosphere while the brine, now cooled to 20 deg. F., was conveyed into a tank and applied to ice making.—Edison Monthly.

GAS FOR INCUBATORS

In a Pacific Coast Gas Assn. wrinkle, Henry Bostwick says that among the experiences that have come to them in the way of supplying gas in the industrial field was that of the poultry business. "Here I find a large volume of our product being used for incubation and brooding of young chicks. While this is not new, yet I doubt if anyone has a rightful appreciation of what it does mean, or may mean, to a supplying company. The representative of one of the gas concerns in California informs me that in his district there is a monthly consumption of nearly 1,500,000 cu. ft. for this purpose alone, one concern using 300,000 cu. ft. This use of gas has displaced other methods, such as oil and electricity, and gas was found to be most reliable and economical. He assures me that the consumers have been making a saving of from 25 to 30 per cent."—Gas Age.

SUFFICIENCY OF THE WATER SUPPLY FOR THE PANAMA CANAL

From a study made of the water supply for the Panama Canal it has been ascertained that an average of 7.21 million cubic feet of water was used for each through lockage from ocean to ocean; that an average of 12,787.47 million cubic feet of water was wasted over Gatun spillway, or a sufficient quantity of water to make 1773 through lockages each month. Based on 30-day operation, this would mean 59 lockages per day over and above the average traffic for the past year. According to the latest annual report of the Governor of the Panama Canal, the maximum number of lockages which can be made in 24 hours is 48, assuming that one vessel leaves the upper flight at Gatun just as another enters the lower chamber, and *vice versa*, both chambers being used.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC
Established 1896

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WHERE WE ALL STAND

We are at the beginning of an age in which it will be insisted that the same standards of conduct and of responsibility for wrong done shall be observed among nations and their governments that are observed among the individual citizens of civilized states. We have no quarrel with the German people. We have no feeling toward them but one of sympathy and friendship. It was not upon their impulse that their government acted in entering this war. It was not with their previous knowledge or approval. It was a war determined upon as wars used to be determined on in the old unhappy days when people were nowhere consulted by their rulers and wars were provoked and waged in the interest of dynasties or of little groups of ambitious men who were accustomed to use their fellow men as pawns and tools.—WOODROW WILSON.

AIRPLANES AND SUBMARINES

We as a nation are now committed to war, with all that the word embodies, and what may be our experiences none can foretell. Of one thing only we may be certain, and that is the seriousness of it. The animus of war has not changed; it still, as always, means slaughter and destruction by all the means available. Like all other of human activities, it has developed from the retail to the wholesale and avails itself of all the modern facilities of efficiency, so that now we can kill and scatter desolation as in the earlier days was never dreamed of, and our only safety and promise of success is in the wise and strenuous employment of all the means which, strangely enough, the years of peace have developed.

The agencies and methods most prominent and most potent in modern warfare are of very recent development, and in all particulars are as far as possible from the weapons offensive and defensive which war through all the ages has wielded and trusted. The Prince of the Power of the Air dominates the situation. The Airplane in the sky and the air propelled torpedo in the deep are now the supreme arbiters of fate. It would now be difficult to over-estimate the importance of the aviator and his equipment. Land warfare cannot be successfully conducted and deciding victories cannot be won without him.

The supreme importance of the airplane being so evident, the thing for us to do is to put into the air a larger number of better machines, with better men to drive them, and above all to get them in the quickest time. Even if supremacy can be attained, it can only be maintained while the strife continues by constant increase in numbers, constant and instant adoption of every improvement, constant increase in the number and the efficiency of aviators and observers. So far as can be seen by the public it would seem that aviation is not getting with us, indeed is far from getting, the urgent drive behind it which the case demands.

The submarine, the submersible, and their supreme weapon of offense, the torpedo, are both compressed air creatures and have brought with them novel problems still demanding solution. The world appalled has to confess that no man has yet devised the means and methods of surely dealing with them. Their essential condition for successful action is in their practical invisibility at ordinary distances and their total disappearance when desired. The one way to cope with them would seem to be in the adoption of the same features in opposition. The submarine may be the only monster to oust the submarine, but the crews for such craft should be ultra-human.

NEW BOOK

Compressed Air for Metal Workers. By Charles A. Hirschberg, 330 pages 8 1-4 by 5 1-2 inches, 294 illustrations, 30 tables. New York. Clark Book Company, $3.00.

This is an eminently practical book, embodying precisely the information most required by users of compressed air and passing more lightly over the theories which appeal to the scientist. It deals principally with dimensions, capacities, costs of operation, etc., giving numerous tables of authoritative data. Descriptions and illustrations of a great variety of air compressors and their appurtenances are presented, and the tools and apparatus using compressed air for their motive power are dealt with copiously. The entire range of metal working in which compressed air is employed seems to be covered although the reach is astonishing. A large portion of the book will of course appeal to those who cannot be classed as metal workers. The matter is systematically arranged and completely indexed.

BY-PRODUCTS OF METALLURGY

Few laymen realize the great impetus given to the metal industries during the past few years by the development and use found for what was formerly discarded as waste. No longer satisfied with obtaining the principal obvious values found in the ores, smeltermen are now realizing—and acting upon their realization—that, as in the packing industry, the real profit of the future will be found in the side lines. It has been rarely found that a proper amount of investigation and research has not opened up some new field of usefulness for what was previously thrown away, and in some cases the new field of use for the by-product has completely overshadowed the former use of the main product. Investigation of the possibilities of such by-products is perhaps the most inviting and promising field in metallurgy today.

Take the case of gasoline. It has not been so very many years ago that kerosene was the principal standby of the oil refineries. They were diluting the kerosene with as much of that troublesome mixture called gasoline as they dared, and were spurring their investigators on to find some way to dispose of the rest. Then the automobile and the general application of the gas engine arrived on the scene hand in hand, and presto! the whole situation has changed. Now as much kerosene as possible is being added to gasoline, and they are busy inventing and trying out new ways to get more of that indispensable fuel out of the same amount of raw oil.

It is not so very long since the total slag from iron blast furnaces was run to waste. Then it was found that with little extra expense, an excellent grade of Portland cement could be made, and a considerable part of it is now so used, although much is still wasted. Slag from the copper blast furnace has not yet found its field of usefulness, although some attempt has been made to form tile and blocks for paving and similar uses out of it. Several railroads are said to express a decided preference for it as ballast, since, on account of its hardness and sharpness, it discourages travel along their lines, by holders of "tie passes."

Arsenic, the half sister of sulphur has also yet to find a large field for use. It is found very widely in nature, and forms an undesirable and many times prohibitive ingredient of certain ores, and is often penalized in copper ore. Arsenic is valuable to decolorize glass, to make certain paints and colors, and is also an important ingredient in many of the sprays used on trees. The total consumption forms only a small part of the amount available. Anaconda alone could probably supply the entire demand in this country. As a matter of fact the Tacoma smelter supplies a considerable fraction of the total production from the ore received from one mine.

Cobalt is another weak sister of the metal family. Having many of the characteristics of nickel, and usually more or less associated with it, Cobalt has shown no such usefulness in the manufacture of high grade steel, nor in alloys. Its principal demand was very limited for colors, for some chemical preparations, and in similar limited uses. Within the last few years, however, an American inventor has succeeded in making an alloy of cobalt and chromium that is so infusible that it can not be melted in any ordinary manner, so hard that it cannot be cut in any way. This alloy promises to be of very important use for cutting tools, as points for sparks plugs, battery points and many other different ways.

A Portland cement plant in California found itself confronted by many damage suits commenced by farmers of the vicinity because of a fine dust pouring from their stack, which settled on the adjacent lands. A Cottrell electrostatic dust precipitation apparatus, the invention of a metallurgist in the service of the Bureau of Mines, was installed, and this caught and settled the dust. A little investigation showed this to be high in potash, and further research enabled them to make a good potash fertilizer out of it. The people who were sueing for the damage done by the dust are now paying high prices for the fertilizer made from it.

One of the most interesting cases of the widening usefulness is in copper smelting. A few years ago the sulphur fumes were not only wasted, but also large amounts were paid out in damages for injury to vegetation. So common was this sort of complaint, and so lucrative its reward in the courts that a regular trade known as "smoke-farmer" sprung up. Then many smelters erected acid plants which recovered a great part of this fume to make sulphuric acid. The demand for high grade acid being comparatively limited, a market was sought for the large quantities of the cheaper product. Copper and zinc leaching developed hand in hand with flotation, and each required its share of the acid, but most important of all was the use in flotation. The development of flotation process has also created a demand for cheap wood, coal and certain mineral oils. This has enabled wood oil manufacturers, gas works and oil refineries to dispose of what had previously been either waste or at best a low priced by-product. This in turn is causing coking plants to consider by-product ovens in their new installations, instead of the old wasteful beehive type, by which nothing was saved. In saving the oil, moreover, more or less ammonia and other products are also recovered, valuable for nitrates and other purposes.

Further, flotation concentrates usually require roasting before they are smelted, and this fume is especially used in making the acid so necessary in recovering the concentrates in the first place. At Anaconda and Utah are very large plants, as elsewhere throughout the country, while over at Tacoma an experimental plant is making liquid sulphur dioxide for bleaching and other purposes, also native sulphur. An acid plant may also be the next development there.

An interesting indication of the thoroughness of the way that these things are being worked out is the fact that at Anaconda, the slime tailing from the flotation plant was found to be very high in alumina, suitable for making fire brick. An excellent quality of pressed brick is now being produced as a result. Thus even the squeal being extracted from the pig in metallurgy if not in the packing business.—Alaska and Northwest Mining Journal.

Reports from Pennsylvania state the famous test well, on which the eyes of the oil world have been centered the past several months, is now down to 7,800 feet, and the drill is still being pushed downward. The well now holds the record for deep wells, exceeding the famous well of Rumania by 500 feet. The well has cost more than $100,000 to date.

NOISELESS FOGHORNS

BY R. E. NEALE

The idea of a noiseless foghorn may seem about as useful as an alarm clock which will not ring. Nevertheless, there are at least two *possible* ways in which a noiseless foghorn may be provided, and, of these two methods, one is already practicable. Indeed, it is already in use. The noiseless foghorn which is already in use, employs electromagnetic waves in the ether—*i. e.,* it is a special application of wireless telegraphy. The noiseless foghorn which is *possible* but not yet practicable would supply vibrations of very high frequency in the air. The sounds we hear are the impression conveyed to our brain by vibrations in the air falling upon our ears. As the frequency of those vibrations is increased (*i. e.*, the distance from crest to crest of the air waves is reduced) we come to a point beyond which our hearing organs fail to respond to the vibrations. So far as we are concerned, there is then silence, but actually the vibrations are just the same as before, except that their frequency or "pitch" has been increased. We have, in fact, a "soundless" sound—a sound which cannot be heard by our ears because of the limitations of their construction and action, but a sound which may quite likely be audible to some other living creatures, and which may be rendered apparent to us if we can only discover a suitable detector.

The "atmospherics," so familiar to every wireless experimenter, have doubtless been going on for countless ages past, yet no one perceived them (much less considered the possibility of generating similar oscillations and using them for signalling purposes) until Hertz devised his simple detector, which was the first parent of all modern radio-telegraphic-receiving apparatus. Some little time before Hertz discovered how to detect what we now call wireless waves, Maxwell had predicted the existence of the latter by his remarkable application of mathematics to physics, but he did not know how to prove the correctness of his conclusions by actually making the electromagnetic waves of these frequencies apparent to human senses.

As regards air waves of very high frequencies, we are now in much the same position as Hertz was before he discovered his radio-detector. None of the human senses is directly sensitive to "wireless" waves, and none is directly sensitive to very high frequency air waves. We know that wireless waves exist, and we know how to produce and apply them; but whilst we know that very high frequency air waves may exist, we do not yet know how to produce them or how to detect them if they are already existent. Once we have solved that problem, we shall probably have another means of transmitting signals, at any rate, over moderate distances, and one very promising application would be in the form of a noiseless syren or foghorn for use between ships at sea or between aircraft in flight.

The noiseless foghorn which we have already at our disposal by suitable application of radio-telegraphy, depends upon the fact that certain shapes of aerial give out "lopsided" signals—*i. e.,* radiate electro-magnetic waves more powerfully in one direction than in another. Conversely, such aerials pick up signals from certain directions more effectively than from others, so that by turning the aerial we can either send out a specially strong signal in any desired direction, or we can tell fairly accurately the direction from which a certain signal is coming. Obviously, both these possibilities are very useful in connection with signal stations on dangerous parts of the coast and for use on vessels moving through fog, but it would be very inconvenient actually to have to move the aerial. Fortunately, the same result can be obtained by purely electrical means. For instance, by using two aerials at right angles, and varying electrically the distribution of energy between them, we can obtain the same radiating effect as would be given by a single aerial at some intermediate position. In other words, we can control electrically the direction of maximum radiation from, or maximum reception by, the compound aerial, and thus send out a specially strong signal in any desired direction, or tell from what direction a received signal is proceeding.

DUST IN EXPLOSIVE MIXTURES

The fact that coal-dust is explosive is very generally known to-day, though only within the last thirty years has it been fully recognized that coal dust alone is explosive without the presence of gas. Experiments have shown that many other carbonaceous dusts are at least as easily ignited and capable of propagating an explosion as coal-dust. While most of the dust explosions reported in surface plants occur in mills and elevators handling wheat, oats, and corn and their products, it appears that no mill handling carbonaceous material is immune from the possibility of explosion. The list of known explosions in other kinds of mills includes those handling dextrine, sugar, starch, malt, wood, linseed meal, cottonseed meal, paper, cork, fertilizer, sulphur, cocoa, and spice dusts.

That flour dust will explode was clearly demonstrated in 1878 by a tremendous explosion in the Washburn Flour Mills in Minneapolis. This disaster aroused milling men to the danger of existing conditions and caused many to take immediate precautions against a repetition of a similar occurrence. The impression was not lasting, and, although a large number of grain-dust explosions occurred later, general interest was not awakened until June 24, 1913, when an explosion occurred in a feed-grinding plant at Buffalo in which 33 men lost their lives and over 70 men were injured. This explosion, which occurred during the ordinary process of milling, completely destroyed the mill and considerably damaged the surrounding property. As a result, an agitation was started between the millers and the Bureau of Mines for the investigation of questions relating to explosions of grain dust. This was later taken up by the Government and is being continued in cooperation between the Bureau of Chemistry and the Bureau of Mines.

LIQUID GREASE FOR LUBRICATING DRILLS

In an article on "Lubrication of Rock Drills" in our April issue, page 8333, several brands of liquid grease were mentioned as suitable for drill lubrication. As the results of later tests several other brands of grease are now considered as good or even better. Among these are to be mentioned the following:

"I R X" Jackhamer and Stoper Grease, Standard Oil Co., No. 6 Keystone Liquid Grease, Keystone Lubricating Co. "B" Absorbed Oil, E. F. Houghton & Co.

HIGH PRESSURE IN PNEUMATIC CAISSONS

In the building of the Paducak & Illinois R. R. Co.'s bridge over the Ohio River at Metropolis, Ill, pneumatic caissons were sunk for the seven river piers. The men worked to an extreme depth of 113 ft., which meant an air pressure of 51 lb. Temperatures also up to 125 degrees F. were recorded in the working chambers. When the conditions were at their extreme of discomfort the shifts were reduced to 3-4 hr. and no serious results developed.

THE SIX METRIC MYTHS

The above is the title of a bulletin issued by the American Institute of Weights and Measures, 20 Vesey Street, New York, and sent free to any address upon request. The myths, which are strongly and convincingly controverted, are as follows:

1. The system is in universal use except in the United States, the British Empire and Russia, and frequently Russia is placed in the metric column.
2. The adoption of the system is easy and the transition period short.
3. There exists a confusion in our weights and measures and the system should be adopted in order to get rid of it.
4. The system leads to an important saving of time in calculations.
5. The system leads to an important saving of time in primary education.
6. The adoption of the system is important in the interest of foreign trade.

NOTES

During the month of November last, according to the report of the Mines Department, there were 9,904 rock drills in commission on the gold mines of the Witwatersrand, but only 6,395 were, on the average, actually in use.

The long abandoned Pond Creek mines, north of Hazleton, Pa., now being opened for the third time, will put into use a number of steam locomotives formerly in service on the New York Elevated Railway.

What is regarded as the greatest percentage of profit ever made from an investment in Oklahoma oil property is reported as made by Samuel A. Apple, Wirt Franklin and Judge

J. W. Harrold. These men attracted by the future prospects of the Healdton field paid $25 for a lease on 100 acres of land in section 9-4-3 and held it for several months. A few weeks ago they sold the acreage to the Sinclair Gulf Oil Company at a price which brought them a little more than $10,000 for every $1 invested.

Paint manufacturers in the United States are uneasy, fearing that some development in the war situation may cut them off from their supply of chalk which is imported to the extent of 200,000 tons annually, and comes largely from Dover, England.

The mount of surface exposed to oxidation in a given mass depends on the size of the particles and increases very rapidly as the fineness approaches that of dust. Dust, therefore, is dangerous in a coal pile, particularly if it is mixed with larger-sized coal which forms air passages to the interior. Spontaneous combustion is brought about by slow oxidation in an air supply sufficient to carry away all the heat formed.

The Wilson Avenue tunnel for the Chicago water supply, 12 ft. in diameter and 8 miles long, is being rapidly lined by the pneumatic process. Four concreting outfits are in use, the men working two 8-hour shifts. In January one outfit mixed and placed concrete in three 30 ft. lengths of forms daily, and on two consecutive days four forms were completed. These 30 ft. forms contain an average of 2 cu. yd. of concrete per lineal foot of tunnel. The pneumatic equipment was furnished by the Concrete Mixing and Placing Company of Chicago.

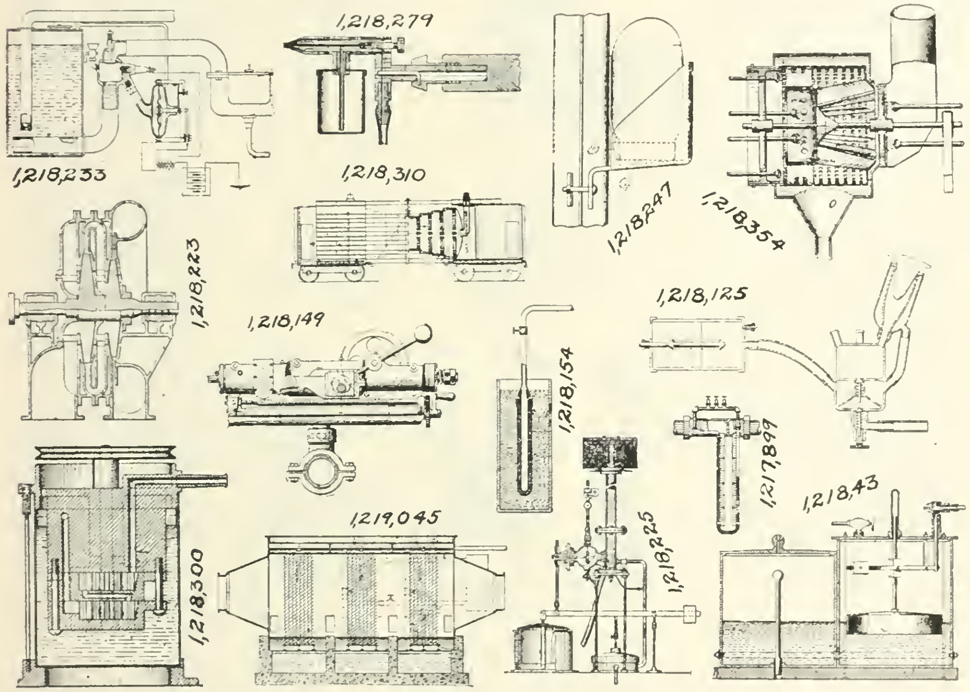
When a modern large gun is fired with nitrocellulose smokeless powder, the temperature of combustion reaches from 4,000 to 5,000 deg. fahr.; and if the powder contains 25 per cent. of nitroglycerine, it may rise to 5,000 to 6,500 deg. Steel melts at 2,650 deg. fahr., and a thin film of steel is fused in about one-sixtieth of a second. As soon as the projectile has left the gun, the big outflow of gas washes away a portion of this thin film of fused steel, and the bore is thus enlarged 0.001-in. in a 14- or 16-in. gun at each shot. With 58 per cent. nitroglycerine, as in some English powders, the erosion is much greater.—Hudson Maxim.

Based both on theoretical investigations and on field tests, the author of Bulletin 376 of the U. S. Department of Agriculture concludes that wood pipe will convey about 15 per cent. more water than a ten-year-old cast-iron pipe or a new riveted pipe, and about 25 per cent. more than a cast-iron pipe twenty years old or a riveted pipe ten years old.

The altitude of Leadville, Colorado, is 10,200 ft. above the sea at Harrison Avenue; Cripple Creek is about 10,000 ft.; Ouray, 7,710 ft.; Deadwood, South Dakota, 4,530 ft.; Lead, 5,300 ft.; Butte, Montana, at the Court House, is 5,767 ft.; Boise, Idaho, 2,739 ft.; Prescott, Arizona, at the Court House, is 5,346 ft.; Bisbee, 5,300 ft.; Jackson, California, 1,975 ft.; Salt Lake City, Utah, 4,248 ft.; and Park City, 6,222 ft.; Virginia City, Nevada, 6,339 ft. The Alaska Treadwell mines are at sea-level, as are numerous others in Alaska and in British Columbia, while there are valuable mines in the South American Andes, at 15,000 to 18,000 ft. above the sea.

Ear-defenders, designed by artillery-men in Europe, are being tried in stamp-mills on the Rand to lessen the effect of the sound on the ear-drums of millmen. The apparatus consists of two small vulcanite plugs, shaped much like the pawns used in a game of chess, and fitting into the ears. A hole is made through the length of the pieces, and at the enlarged bell-mouth end a fine wire-screen is fixed. This screen breaks the waves of sound. At the Knights-Deep mill (120 stamps) it was considered that a broken stem or any unusual noise was more easily detected when wearing the defenders. Also, hearing becomes normal quickly after leaving the plant. The use of cotton-wool in the ears is not always safe, sometimes causing obstructions later on.

It often happens that the gas supply in city mains is at a too high pressure to be used with economy in gas stoves, and in any case there is danger of using considerably more gas than is really needed, so that a device for reducing the pressure will prevent waste of gas in quite a number of cases. A simple device of this kind has one end connected by hose to the mains, while the gas comes out of the other end and goes by a second hose to the burner. Between the high and the low pressure sides is placed a partition containing a set of fine holes, so that the gas can only pass through at a reduced rate, and this is found to lower the pressure very effectively.



Pneumatic Patents March 6

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MARCH 6.

1,217,899. METER FOR STEAM, AIR OR OTHER GASES. George Hale Barrus, Brookline, Mass.

1,217,901. FLUID-PRESSURE-REGULATING VALVE. Charles L. Bastian, Chicago, Ill.

1,218,045. AIR-CONDITIONING APPARATUS. Harry Bentz, Montclair, N. J.

1,218,125. MILKING-MACHINE. David Townsend Sharples, West Chester, Pa.

1,218,134. VACUUM-CLEANER. Hugh C. Tyler, Columbus, Ohio.

1,218,149. ROCK-DRILL. James C. Wright, Colorado.

1,218,154. METHOD OF TESTING FILTER-BODIES. Edward Zahm, Buffalo, N. Y., assignor to Zahm Manu

The hereindescribed method of testing a porous filter body for determining the size of the pores therein comprising wetting said body so that the interstices are liquid sealed and then subjecting the same to gas pressure and determining the pressure at which the seal is broken.

1,218,223. CENTRIFUGAL BLOWER. Charles H. Smoot, New York, N. Y.

1,218,225. SIGNALLING APPARATUS. Chas. Alexander Stevenson, Edinburgh, and John Moyes, Glasgow, Scotland.

1. An apparatus of the character stated, comprising, in combination, an explosion chamber, pulsating apparatus adapted to supply gas periodically thereto, means, operable from the pulsating apparatus, for supplying air periodically to the explosion chamber, an ignition device for effecting the ignition of the mixture in the explosion chamber, and means for periodically operating said ignition device from said pulsating apparatus.

1,218,233. PRESSURE-GENERATING DEVICE. Fred S. Welch, Pontiac, Mich.

1. In a sprayer, the combination of an air tight tank, liquid therein, a combustion chamber, said combustion chamber communicating with said tank below the liquid level therein, and means for causing explosions in said chamber whereby the gas is transferred under pressure from said combustion chamber to said tank.

1,218,247. HUMIDIFIER. John E. Dutcher, Chicago, Ill.

1,218,279. AIR-BRUSH. August Kopinski, Chicago, Ill.

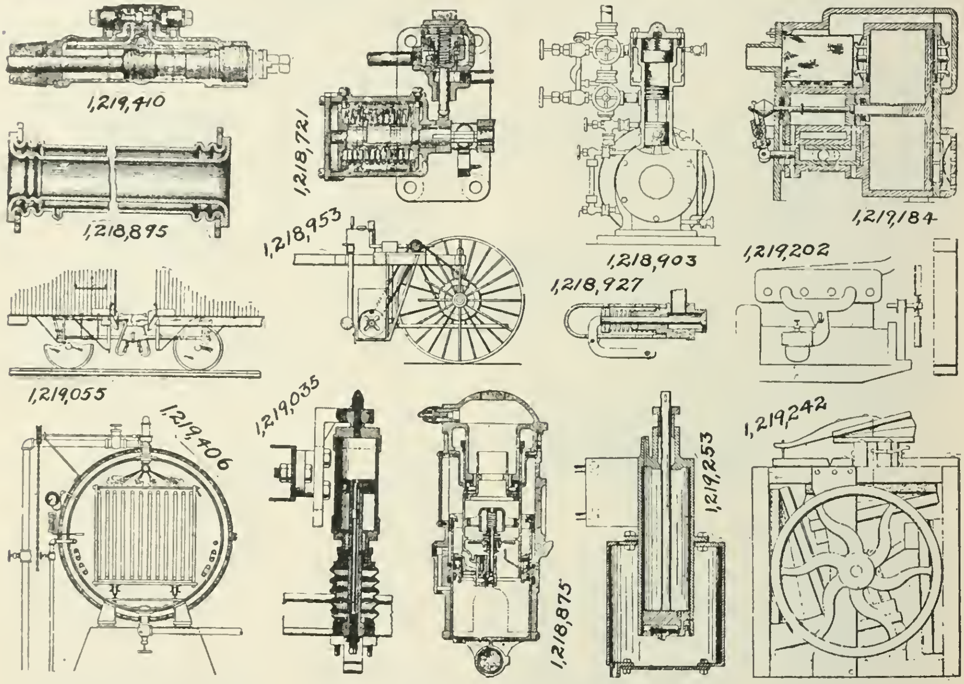
1,218,291. COMBINED AIR AND STUFFED CUSHION. Christian W. Meinecke, East Orange, N. J.

1,218,300. VACUUM-PUMP. George F. Nelson, Berkeley, Cal.

1,218,310. PNEUMATIC-DYNAMIC CAR FOR DIMINISHING THE DESTRUCTIVE EFFECTS OF RAILROAD COLLISIONS. Pasquale Penza, Bologna, Italy.

1,218,354. PROCESS FOR THE SEPARATION OF DUST PARTICLES AND SMOKE FROM AIR AND GASES. William J. Baldwin, Brooklyn, N. Y.

1,218,446-7. MILKING-MACHINE. Mark J. Murphy and Harry H. Brandeau, St. Paul, Minn.



Pneumatic Patents March 13

1,218,543. GAS - PRESSURE REGULATOR. Bernhardt Mathias Gattermeir, California, Mo.

MARCH 13.

1,218,721. TRIP-VALVE DEVICE FOR AIR-BRAKES. Walter V. Turner, Edgewood borough, Pa.

1,218,875. VARIABLE-LOAD AIR - SPRING. Richard Liebau, Swissvale, Pa.

1,218,895. PIPE FOR THE CONVEYANCE OF FLUIDS. Edwin H. Porter, Philadelphia, Pa.

1. An integral unit for pipes for conveying fluids with a minimum of heat transference between the interior bore or passage of the pipe and the exterior, comprising a duplex tubular metallic casing having imperforate inner and outer walls inclosing an exhausted or vacuum annular space extending substantially throughout the length thereof, said walls being united at the ends into a single wall, and having corrugations adjacent the union of the walls at each end to accommodate the variations in the expansion of the walls and relieve the strains at the points of union between the inner and outer walls of the duplex casing.

1,218,903. COMPRESSOR. John C. Scovel, Jr., Chicago, Ill.

1,218,927. FOOT AIR-ACCELERATOR FOR HYDRO-CARBON-MOTORS. Ernest Bussey, Dothan, Ala.

1,218,953. SPRAYING AND POWDER-DUSTING ATTACHMENT. Frank Oldham, Dallas, Tex.

1. In a spraying and powder dusting attachment, a base plate adapted to be mounted on a wheel supported frame of a cultivator, an air compressor mounted on the plate, a liquid tank connected with the air compressor, a hanger carried by the plate, a powder dusting hopper carried by the hanger and having provision for dusting powder, and a nozzle carried in advance of the hopper and connected with the tank.

1,218,991. COMPOUND APPARATUS FOR CASTING METALS IN VACUUM. Erminio Ferrari, Venice, Italy.

1,219,035. SHOCK - ABSORBER. Ralph H. Pettengill, Haverhill, Mass.

1,219,055. AUTOMATIC AIR-COUPLING DEVICE FOR RAILWAY-TRAINS. Claud L. Turner, Perry E. Whitehead, and Sye C. Clarke, Gering, Nebr.

1,219,104. PNEUMATIC DEVICE FOR PLAYER-PIANOS. Charles V. Jameson, Chicago, Ill.

1,219,121-2-3-4-5. AIRSHIP OR DIRIGIBLE BALLOON. Thomas Rutherford Macmechen and Edwin Marshall Fox, Westminster, London, England.

1,219,184. HYDRAULIC MOTOR-DRIVEN AIR EXHAUSTER AND COMPRESSOR. Stanley M. Stone, New York, N. Y.

1,219,202. AIR-REGULATOR FOR ENGINE-MANIFOLDS. Emile Waldmeier, Gulport, Miss.

1,219,242. FOUR-WAY VACUUM-PUMP. Paul I. Burks, Louisville, Ky.

1,219,253. AIR RAILWAY-BRAKE. Samuel Cheney, Wickepin, Western Australia, Australia.

1,219,388. ART OF IMPREGNATING TIMBER AND OTHER MATERIAL WITH A PRESERVATIVE. Oliver P. M. Goss, Seattle, Wash.

1. In the preserving treatment of porous material, the method which consists in first heating the material in a bituminous preservative, in a close container, to approximately 230 degrees Fahrenheit under normal pressure, then drawing a vacuum of approximately 15 to 28 inches in the container and maintaining the heat of the latter at a temperature above that of boiling water under said vacuum for not less than half an hour, then breaking such vacuum, and applying pressure sufficient to force approximately from five to twenty pounds of the preservative fluid into the pores of each cubic foot of material.

1,219,391. HUMIDIFIER. Hugh S. Grigsby, Richmond, Va.

1,219,406. PROCESS OF DRYING AND EXTRACTING. Daniel B. Banks, Baltimore, Md.

1,219,410. PRESSURE-ACTUATED VALVE. Frank E. Willey, Claremont, N. H.

MARCH 20.

1,219,477-8. DRILL-SHARPENER. Edward L. Oldham, Denver, Colo.

1,219,498. OPERATING MECHANISM FOR ROCK-DRILLS. William A. Smith, Denver, Colo.

1,219,511. AIR-COMPRESSOR. Carl W. Weiss, Brooklyn, N. Y.

1. In combination with a cage, a valve unit carried on the cage and composed of a seat, a plate valve and a guard, said seat being invertible and the seat and the guard being interchangeable in position relative to the cage without disturbing their operative relation to the plate valve whereby the valve may be caused to act either as an inlet or outlet valve with said cage.

1,219,606. BRAKE-CYLINDER-PRESSURE REGULATOR. Walter V. Turner, Edgewood, Pa.

1,219,642. SPRAYER. Joel L. Isaacs, Chicago, Ill.

5. In an appliance of the character described, the combination of a duplex nozzle adapted to deliver a coating material under pressure in the form of a spray, and means to deliver a tube of compressed-air under greater pressure surrounding and confining said spray, substantially as described.

1,219,645. METHOD OF PRODUCING BLASTING CHARGES IN WHICH LIQUID AIR IS USED. Ambrose Kowastch, New York, N. Y.

1,219,710. VACUUM CASTING DEVICE FOR GOLD-INLAY WORK AND THE LIKE. Frank B. Davis, Johnstown, Pa.

1,219,723. PNEUMATIC ALARM SYSTEM. Frank T. Gracey and Thomas W. Lander, Eddyville, Ky.

1,219,756. VACUUM-CLEANER. Hubert Meredith Jones, New York, N. Y.

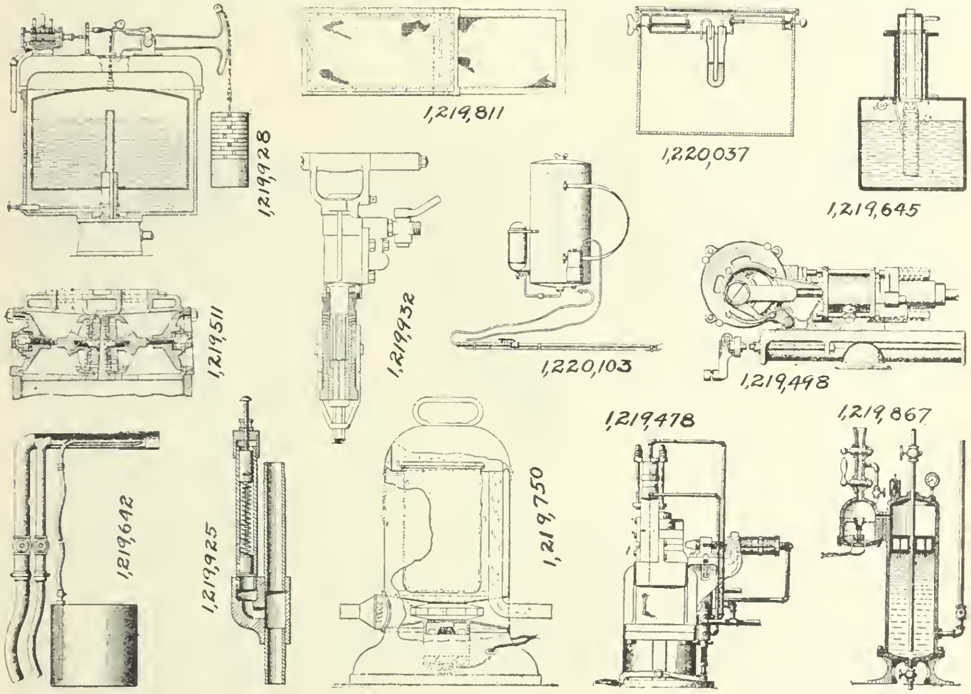
1,219,811. AIR-PURIFYING AND VENTILATING DEVICE. William D. Doty, Streator, Ill.

1,219,867. PRESSURE-PRODUCING APPARATUS. William J. Reilly, Denver, Colo.

1,219,925. AUTOMATIC VALVE FOR INFLATING TIRES. Franklin A. Dean and William H. Little, Alta Vista, Kans.

1,219,928. FLUID-PRESSURE GOVERNOR. Ralph C. Enyart, Connersville, Ind.

1,219,932. PNEUMATIC TOOL. Norris H. Frost, West Hoboken, N. J.



PNEUMATIC PATENTS MARCH 20

1,219,970. PROCESS FOR CONVERTING STEAM HEAT OF A LIQUID INTO MOTIVE FORCE. Karl Prinz zu Lowenstein, Kleingemund, near Neckargemund, Germany.

1. The process substantially as described, which consists in supplying a compressed fluid to an engine, admitting a heat carrier to said engine, allowing the fluid and heat carrier to expand, causing the fluid to absorb the heat of said carrier, and finally recompressing the fluid and returning it to its source of supply.

1,220,037. APPARATUS FOR INDICATING THE COMPOSITION OF GASES. Hans Haupt and Martin Werner, Berlin, Germany.

1,220,076. PNEUMATIC ACTION FOR PLAYER-PIANOS. Jesse L. A. De Yoe and John W. De Yoe, Castleton, N. Y.

1,220,100. FLUID-PRESSURE HAMMER. Charles H. Haeseler, Philadelphia, Pa.

1,220,103. DEVICE FOR PROJECTING BURNING LIQUIDS. William A. Hall, New York, N. Y.

MARCH 27.

1,220,297. VACUUM APPARATUS. Harold Vanderhoof, San Francisco, Cal.

1,220,323. PNEUMATIC RETRIEVING-TROLLEY. Albert M. Eaton, Santa Monica, Cal.

1,220,336. FLUID-PRESSURE SYSTEM. Harry H. Hornsby, Chicago, Ill.

1,220,497. AIR-MOISTENING ATTACHMENT FOR INCUBATORS. William Lansing Cornell, Brown Mills, N. J.

1,220,503. AIR-PIPE COUPLING. Henry C. Duty and Leroy L. Craig, Pittsburg, Ill.

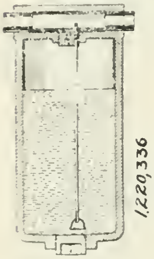
1,220,538. AIR-REMOVING DEVICE FOR WATER-PIPE LINES. Charles A. Olson, Geneva, Ill.

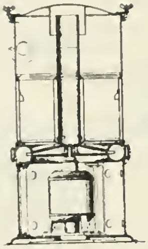
1,220,551. PNEUMATIC STABILIZER FOR VESSELS. George E. Powell, Chicago Heights, Ill.

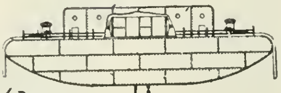
1. A vessel having stabilizing chambers in opposite sides, communicating with the water through openings below the normal water line, each chamber having a valve and a vent controlled by said valve and means to cause said valve to open when said stabilizing chamber rises by a roll of the vessel and permit free ingress of water to said chamber, and to close when said chamber moves downwardly.

1,220,618. WAVE-MOTOR. Herbert E. Fisher, San Francisco, Cal.

The combination with a float having an air receiver thereon of a pair of hollow cone-shaped members; a flexible diaphragm consisting of radial members thereby forming a pressure chamber adapted to be normally compressed by the pressure of surrounding water; a covering of flexible fabric secured above the radial members; a second radial member interposed between the first mentioned members and the fabric and secured to every alternate radial member and overlapping each adjacent radial member thereby preventing pressure from forcing the fabric between the first mentioned members; suitable flexible connections between the air chambers and the air receiver on the float; and a suitable cable secured to each cone-shaped member and the diaphragm therefor and to each end of the float, and adapted to raise the diaphragm and thereby expand the compression chamber and to raise the cone-shaped member when said compression chamber is expanded, when that end of the float is raised by the action of waves.


1,220,336


1,220,641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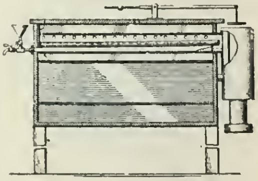
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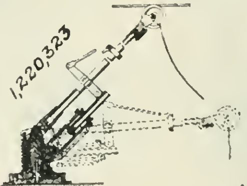
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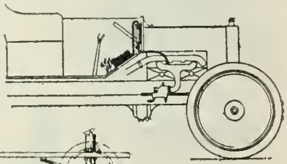
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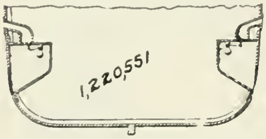
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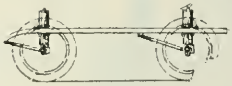
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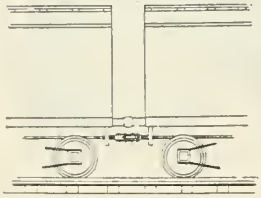
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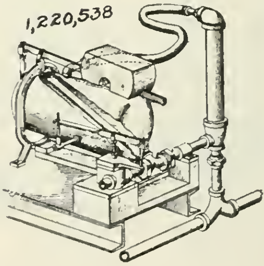
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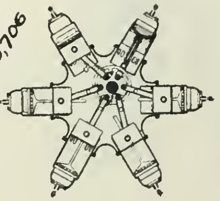
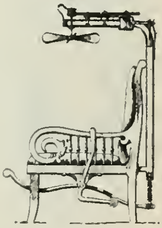

1,220,706


1,220,628

Pneumatic Patents March 27

1,220,628. FAN ATTACHMENT FOR CHAIRS. Albert Edmond Hauser, Pelican, La.

1,220,630. AIR-CUSHION DEVICE FOR VEHICLES. Ralph Victor Hayes, Brooklyn, N. Y.

1,220,641. VACUUM-CREATING AND DUST-SEPARATING MACHINE. Bert M. Kent, Washington, D. C.

1,220,706. ROTARY-CYLINDER MOTOR. Felix Joseph Charlemagne Tesse, La Varenne St. Hilaire, France.

1,220,805. AIR-DISTRIBUTER FOR INTERNAL-COMBUSTION ENGINES. Carl W. Weiss, Brooklyn, N. Y.

COMPRESSED AIR MAGAZINE

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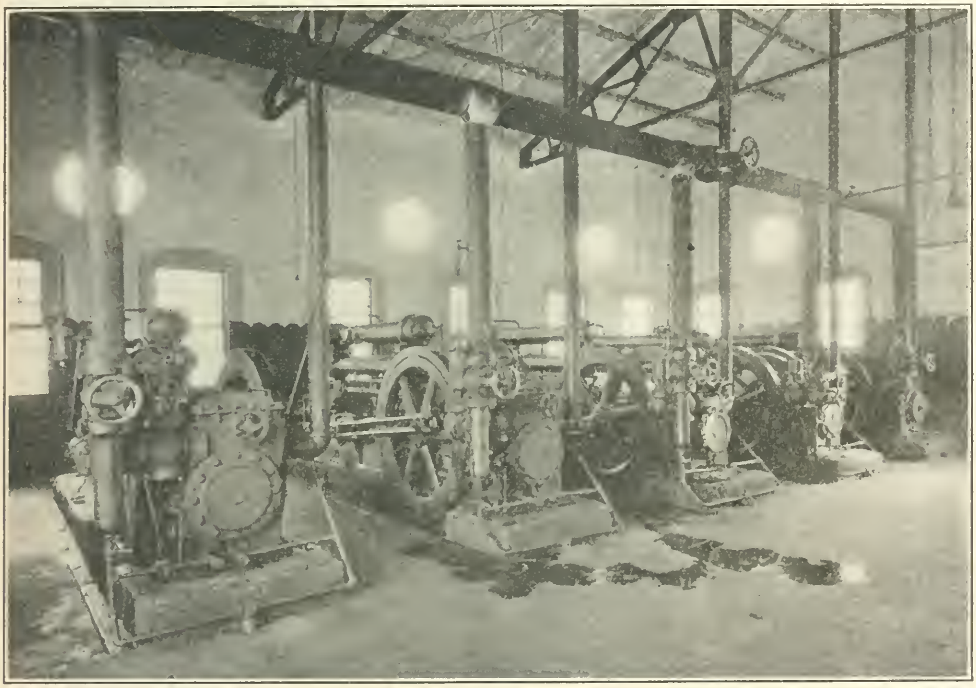


THE COMPRESSORS THAT WERE SCRAPPED.

SAVING BY SCRAPPING AIR COMPRESSORS

BY STEPHEN W. SYMONS

It would be difficult to find a more striking illustration of the economies that can be effected by the substitution of modern equipment for old than that offered by the Pennsylvania Coal Co., at its No. 6 colliery near Pittston, Pennsylvania.

In this plant the company had a battery of seven straight-line, simple-engine-driven, three-stage air compressors for charging haulage locomotives. Each machine had air cylinders of 11½-in., 9-in. and 4½-in. in diameter, with a common 20-in. stroke. At a speed of 250 r.p.m., these machines had a piston displacement of 600 cu. ft. of free air per minute each, or a total piston displacement of 4,200 cubic feet.

The air-haulage system having been discarded, the air from these compressors was turned into the main pipe line, supplying hoisting engines, drills, etc., its pressure being reduced to 100 lb. by means of a Foster reducing valve. Besides the high-pressure machines, there were two straight-line, single-stage compressors supplying air at 80 lb. to another portion of the mine. These machines had air cylinders 26¼ in. in diameter, steam cylinders 22 in. in diameter, with a stroke of 30 in., and a total piston displacement of about 2,800 cu. ft. per minute, making the capacity of the entire plant, on the basis of piston displacement, 7,000 cu. ft. per minute.

The three-stage machines had been installed some 10 or 12 years ago and, after the change from high- to low-pressure service, it did not take the operating company long to realize that the plant was decidedly inefficient and so costly in operation as to warrant installing more economical and up-to-date machines.

After the usual period of investigation, it was decided to install an Ingersoll-Rogler corliss-engine-driven compressor, with two-stage air cylinders of 29- and 18½-in. diameter respectively, and compound steam cylinders of 23- and 21-in. diameter, having a 24-in. stroke and a piston displacement of 2,550 cu. ft. per minute, and discard the seven three-stage, straight-line machines. A new system of pipe lines, which eliminated restricted orifices, leakage, etc., was also installed, to take the place of both former systems.

After the new compressor was started up, it was found to be unnecessary to continue the operation of the two low-pressure machines, as the new compressor would take care of the entire mine. The effect on the steam consumption of the plant was extraordinary. No exact figures are available, but a fairly accurate estimate can be made of the consumption of the different machines, from which the total saving can be approximated.

It is safe to say that the steam consumption of the seven three-stage machines, when operating at the high speeds mentioned, would total 44,000 lb. per hour; the loss in reducing the air to the working pressure of 100 lb. being considered. The two single-stage machines, when operating at their rated capacity, would require 504 i.hp., which, based on a steam consumption of 40 lb. per i.hp.-hr., would require the evaporation of 20,000 lb. of water, making a grand total of 64,000 lb. of steam per hour for the entire compressed-air plant.

The new compressor, which is operating noncondensing, has a steam consumption of about 21 lb. per i.hp.-hr. and, when developing its normal load of 400 hp., would require 8,400 lb of steam per hour. Assuming that 1 lb. of coal would evaporate 5 lb. of water, it would require 12,800 lb. of coal per hour to operate the old plant and only 1,680 lb. per hour for the new, thus making a saving of 11,120 lb. of coal per hour.

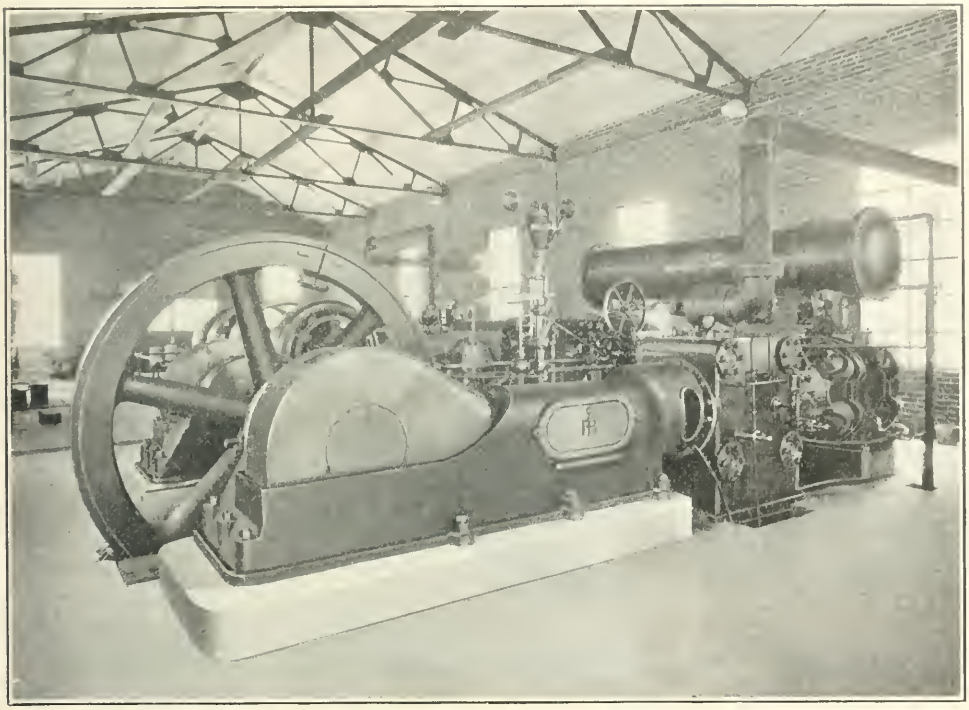
On a basis of cost this would amount to 55.6 short tons per 10-hour day, or 16,680 tons per year of 300 working days, which, with coal at 50c. per ton, would represent a saving of $8,340 per year. At this rate, assuming that the compressor cost $15,000 installed, it would take but two years to pay off its entire first cost.

The saving in water was, of course, 64,000 —8,400 = 55,600 lb. Another remarkable saving, due largely to the refinements in the design of the new machine, was realized in the reduced consumption of lubricating oil, both for the cylinders and running gear. Both steam and air cylinders of the new machine are lubricated by force feed, this alone resulting in a reduction in the amount of oil required besides providing more perfect lubrication. Add to this the fact that, in the old plant, there were no less than 23 air cylinders and nine steam cylinders to feed, against two steam and two air cylinders in the new plant, and the saving is apparent.

More striking still is the reduction in the oil required by the running gear. The old machines were all of the twin-flywheel, outside-crank type, with the entire running gear lubricated by means of oil cups, while the new machine is of the wholly inclosed type, with the running gear lubricated by an automatic flood system, which only requires a small quantity of oil to be added every month to that already contained in the system.

A rough estimate of the saving in lubricant can be made as follows: Experience has shown that a 24-in. stroke compressor with flood lubrication requires about 15 gal. of oil per month, added to that contained in the reservoir in the main frame or crank case, to make up for losses. This amounts to about 180 gal. per year of 300 working days and, with oil at 25c. per gallon, would represent a cost of $45 per year.

The seven 20-in. and two 30-in. stroke straight-line compressors with oil-cup lubrication would be provided with oil cups on the main bearings and eccentrics, for crank and crosshead pins, piston rods and guides, at least twelve cups being provided for each machine, or 108 cups in all, having an average capacity of ¼ pint each. These cups would have to



ONE COMPRESSOR MORE THAN ENOUGH.

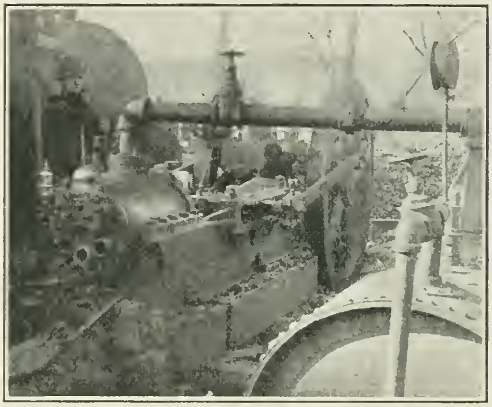
be filled on an average three times a day or, roughly 1 gal. of oil per machine per day, a total oil consumption of 9 gal. per day, or 2,700 gal. per year of 300 working days, representing a cost of $675. The saving, to the credit of the new machine, would be $630, even more remarkable in its way than that realized on fuel and water. The greater cleanliness of the new machine is also marked.

The saving on attendance was equally noticeable, to say nothing of the saving in handling coal and ashes, maintenance and attendance on boilers, of which several were shut down, saving on buildings due to the smaller floor space, etc. A statement of repair cost, of course, cannot as yet be given, but it will obviously be less for a single machine, new and of modern design, than for nine old machines that had about reached their limit of usefulness.

Of course, the credit for this remarkable performance is by no means entirely due to the higher efficiency of the new machine, but arises chiefly from the fact that the rated capacity of the old plant was more than twice as much as was actually required; and this in turn is accounted for, first by the method of basing these capacities on piston displacement, which is a misleading term, and secondly on the condition of the original pipe line, which was not properly designed and showed some leakage. The original plant was of such old design, and the machines were operating so much over speed, that while they were producing more than their rated capacity at normal speed, this was but little more than 50 per cent. of their piston displacement at the increased speed.

The question of the design of pipe lines is one that has been generally neglected. There is no reason why a properly installed pipe line should show any appreciable leakage and, when designed with due reference to the capacity of the plant and terminal pressure required, the loss due to friction should be a negligible quantity.

There are many other plants, in the coal districts, where similar changes could be made with profit—plants where practically obsolete equipment has been nursed and coddled along by the mine operators for years, with the idea that, because fuel at the mine is cheap, they can afford to operate extravagant machines. But fuel cost is by no means the only cost; maintenance, depreciation, attendance, boilers, coal- and ash-handling, etc., all enter into the account.



A COMPRESSOR SURVIVOR

A COMPRESSOR IN SERVICE THIRTY YEARS OLD

BY H. L. HICKS

Contractors, especially small ones, often employ machinery that has outlived what might be counted a reasonable period of usefulness, an apt illustration of which is presented in the little photo reproduced on this page. The shop number (264) of the compressor here seen identifies it as having been built in 1887 in the New York City shops of the Ingersoll Rock Drill Company. The air and steam cylinders are 10 in. diameter and 18 in. stroke. One striking feature is the absence of a water jacket. The air in the cylinder is cooled by a spray of water pumped into the cylinder with each stroke. This early arrangement is less effective than even the insufficient water-jacketing of the machines which immediately followed and is not to be compared with the devices of the present day. This compressor was built for the Hackensack Water Co. for aerating water, and was in continuous use for ten years; then, after a period of idleness, it passed into the hands of contractors and was employed on various jobs. It is now operating rock drills on a foundation excavation, giving continuous service with scant attention.

OVERWHELMING DISASTER TO ALASKA-TREADWELL MINES

A most unusual disaster has apparently put an end to the great Alaska Treadwell mine on Douglas Island, Alaska. It seems unlikely that any engineering scheme can recover it from the grasp of the sea, which a week ago burst through the narrow barrier of rock formerly protecting the mine and flooded the historic workings. Reports from Juneau indicate that the loss is irrevocable, as one might indeed suppose from a bare statement of the facts. The mine has become, one might say, an arm of the sea, and with the subsequent dashing of the waters, the condition will only become worse. The Alaska-Treadwell has been worked to great depth below sea level, and it would probably require years, if such an attempt were within the pale of wisdom, to open working chambers below in such manner as to avoid a further inpouring of the ocean. Only at an enormous cost, if at all, could the property be made to again yield a profit from the extremely low grade of gold ore which has hitherto been made to earn dividends. The Treadwell ores have run between $2 and $3 a ton, and only through a policy of handling immense tonnages, subject to treatment in a great amalgamation and cyaniding mill, has the mine been made to pay. Such immense tonnages can probaly never be handled again by any means which capital would be willing to risk. This remarkable mine was opened thirty-five years ago and has earned many millions of dollars. The Alaska Treadwell company, which was recently consolidated with other companies, paid to its stockholders more than $15,000,000. The mine lies about two miles southeast of Juneau, upon the edge of Gastineau channel, the waters of which have now taken possession of the workings. The values occur in a huge dike, 450 feet in thickness, which cuts through the altered slate country. The dike itself is filled with numerous small seams in which the gold occurs with pyrite. Other properties upon the same dike are still working, and will continue to work. It is hard to realize that the famous Treadwell is a thing of the past, the end has come with such startling suddenness. It has been a proverb of low mining and milling costs for prospectus writers of the last twenty-five years. —*Mining American.*

TABLE I.

Cost Of Coal At One Dollar Per Ton To Compress And
Deliver 100 Cu. Ft. of Free Air

(Multiply figures in table by price of coal in dollars per ton) Ton = 2000 lb.

Weight of Steam - In Pounds - Required by the Engine - Per Horsepower per Hour.										
	24	26	28	30	32	34	36	38	40	42
Weight of Coal - In Pounds - Per Horsepower Per Hour - When Boiler Is Evaporating 7 lb. of Water Per Pound Of Coal.										
	3.43	3.714	4.	4.286	4.571	4.757	5.143	5.428	5.714	6.
Brake H.P. to deliver 100 cu.ft. free air per minute	Cost of Coal Per H.P. Hour At One Doller Per Ton - -Fractions of Cent-									
	.1715	.1857	.2	.2143	.2285	.2378	.2571	.2714	.2857	.3
	Cost Of Coal Per 100 Cubic Feet Free Air - -Fractions of Cent-									
16	.0457	.0495	.0533	.0572	.0610	.0634	.0686	.0724	.0762	.08
18	.0514	.0557	.06	.0643	.0686	.0714	.0772	.0814	.0857	.09
20	.057	.0619	.0667	.0714	.0762	.0793	.0857	.0904	.0952	.10
22	.0627	.0681	.0733	.0785	.0838	.0872	.0943	.0995	.1047	.11
24	.0684	.0743	.08	.0857	.0914	.0951	.1029	.1085	.1142	.12
26	.0741	.0805	.0866	.0929	.099	.103	.1114	.1175	.1238	.13
28	.0798	.0867	.0933	.10	.1066	.1109	.12	.1266	.1334	.14
30	.0855	.0929	.10	.1071	.1142	.1189	.1285	.1357	.1429	.15

Example - If it requires 22 brake horsepower to deliver 100 cubic feet of free air per minute at 90 lb. pressure, and the compressor is driven by an ordinary steam engine requiring 34 lb. of steam per horsepower hour, and an ordinary boiler evaporating 7 lb. of water per pound of coal, and with coal at \$6 a ton - the coal cost per 100 cubic feet of free air is .0872 x 6 = .5232 cent.

H. V. Conrad.

COST OF COMPRESSING AIR BY DIFFERENT DRIVES

BY H. V. CONRAD

In considering the purchasing of a relatively small air compressor unit, say 50 to 100 horse power capacity, it is often desirable to consider various sources of power for operating it and the cost of fuel. Data given in the Practical Reference Tables have been compiled to show readily these comparisons wherein the air compressor is to be driven either by:

I. Steam Engine, direct connected or belt driven.

II. Gasoline Engine, direct connected or belt driven.

III. Electric motor, direct connected or belt driven.

It may be noted from the example given in each table that to compress and deliver 100 cu. ft. of free air at 90 lb. pressure,

I. The cost of coal will be.. 0.5232 cent

II. The cost of gasoline will be .... 1.08 cents

III. The cost of electric current will be .... 1.1 cents

when the cost of coal is taken at \$6 per ton, gasoline at 22c per gallon, and electric current furnished by a steam operated commercial distributing plant at 4c per kilowatt-hour.

In using these tables it is, of course, necessary to assume certain figures suiting local conditions in order to make proper comparisons, after first determining the horsepower required to compress and deliver 100 cu. ft. of free air per minute and assuming the mechanical efficiency of all the machines is about the same:

In Table I, the steam consumption of the engine must be approximately determined. In the example, it is taken at 34 lb. per horsepower per hour; if it were 17 lb., the cost of coal would be ½. The boiler evaporation in the table is given as delivering to the engine 7 lb. of water for each pound of coal burned, and any percentage of variation from this performance should appear in the calculations.

TABLE II.

Cost Of Gasoline In Cents To Compress And Deliver 100 Cubic Feet Of Free Air.

Gasoline Consumption One Pint Per Brake Horsepower Per Hour

Brake Horsepower to Deliver 100 Cubic Feet Free Air Per Minute	Price Of Gasoline Per Gallon -Cents-							
	8	9	10	11	12	13	14	15
16	.266	.300	.333	.366	.400	.433	.466	.500
18	.300	.337	.375	.413	.450	.487	.525	.562
20	.333	.375	.416	.458	.500	.542	.584	.626
22	.366	.412	.458	.504	.550	.595	.642	.687
24	.400	.450	.500	.550	.600	.650	.700	.750
26	.433	.488	.542	.596	.650	.705	.759	.813
28	.466	.525	.583	.642	.700	.758	.816	.875
30	.500	.563	.625	.688	.750	.813	.875	.938

Example:- If it requires 22 Brake Horsepower to deliver 100 cubic feet of free air per minute at 90 lb. pressure, and gasoline at 22 cents per gallon, the gasoline cost per 100 cubic feet of free air is .504 x 2 = 1.08 cents.

H. V. Conrad.

When the final figure of cost in the table is determined, it must be multiplied by the cost of coal in dollars per ton. A steam driven compressor requires boiler power, and the cost of this and the expense of operating it must be considered, when comparing with other sources of power, aside from the cost of coal, which latter is covered by the table.

In Table II, the gasoline consumption per brake horsepower will not vary greatly, but the percentage of variation should be considered. If keroene or other oils are burned

TABLE III.

Cost Of Electric Current In Cents To Compress And Deliver 100 Cubic Feet Of Free Air

Brake Hp. To Deliver 100 Cu. Ft. Free Air Per Minute	Price Of Electric Current Per Kilowatt-Hour - Cents								
	1.	1.5	2.	2.5	3.	3.5	4.	4.5	5.
	Per Horsepower Hour - Cents								
	.75	1.125	1.5	1.875	2.25	2.625	3.	3.375	3.75
16	.2	.3	.4	.5	.6	.7	.8	.9	1.0
18	.225	.337	.45	.562	.675	.787	.9	1.012	1.125
20	.25	.375	.5	.625	.75	.875	1.0	1.125	1.25
22	.275	.412	.55	.687	.825	.962	1.1	1.237	1.375
24	.3	.45	.6	.75	.9	1.05	1.2	1.35	1.5
26	.325	.487	.65	.812	.975	1.137	1.3	1.46	1.625
28	.35	.525	.7	.875	1.05	1.225	1.4	1.575	1.75
30	.375	.562	.75	.937	1.125	1.312	1.5	1.687	1.875

Example:- If it requires 22 Brake Horsepower to deliver 100 cubic feet of free air per minute at 90 lb. pressure, and electric current at 4. cents per kilowatt-hour, the electric current cost per 100 cubic feet of free air is 1.1 cents.

H. V. Conrad.

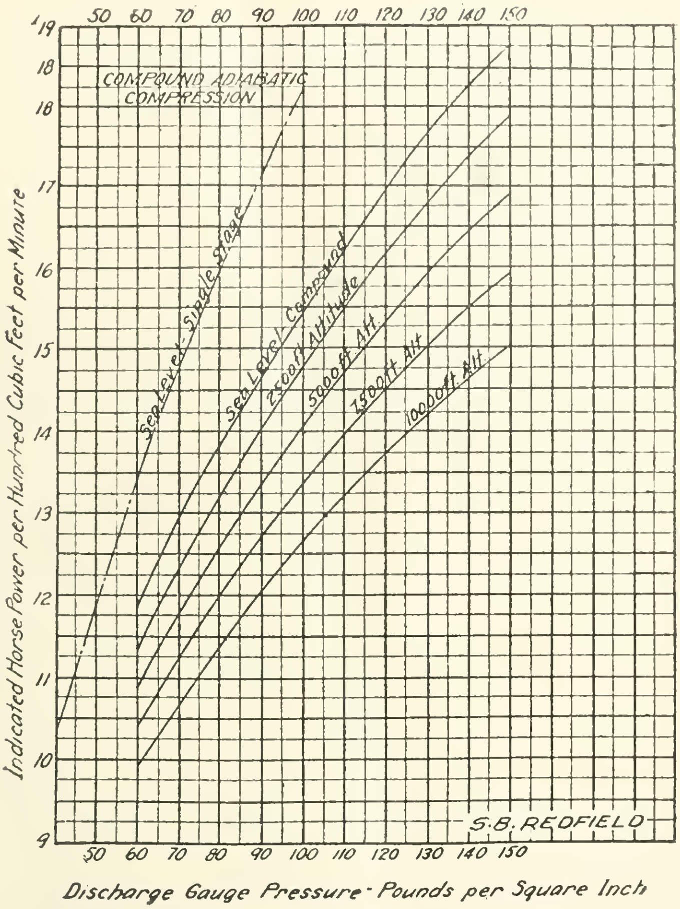
instead of gasoline, the price per gallon should be determined, also the consumption per brake horsepower.

In Table III, it is assumed that the consumer may wish to buy electric current from some power plant.

The figures in all the tables are given in multiples so that missing ones can readily be determined; for illustration, if 100 cu. ft. of free air requires 10 hp., ½ the horizontal column of 20 or ⅓ of 30 can be taken. If gasoline costs 20c., multiply by 2 the column given under 10c. If electric current costs 6c., multiply by 2 the column given under 3c.

These tables can be used to advantage in considering a plant of any size or efficiency.

NOTE.—In the cost figures the element of time need not be considered in compressing 100 cu. ft. of air, whether it requires ¼ min., ½, etc., to do the work.—*Practical Engineer.*



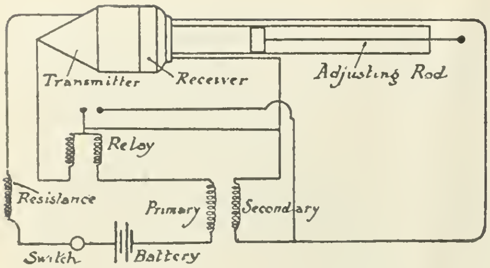
HORSE POWER DIAGRAM.

DISTANT CONTROL OF AIRCRAFT BY RESONANCE

An Australian inventor has developed an ingenious device which may be employed for directing and controlling aircraft from a distance, and is claimed to possess advantage over wireless methods in that its operation cannot be interfered with by enemies or others. The following descriptive sketch is taken from *Flight*, London, whose representative was permitted to witness a demonstration.

The leading idea of the device is found in the well known principle of sympathetic resonance. This may be readily demonstrated by the simple experiment of pressing down the "loud" pedal of a piano and playing a note on some other instrument—a violin, for instance. The corresponding note will then sound on the piano.

The resonator consists fundamentally of a telephone transmitter and receiver, facing one another and placed a short distance apart, the space between them being enclosed in a cylindrical casing which confines the air, thus amplifying the reaction between transmitter and receiver. To the back of the receiver is attached a tube in which works a piston operated by a short rod. By moving the piston in and out the length of the air column behind the receiver is changed, and consequently the note emitted when the diaphragms of transmitter and receiver are vibrated is altered correspondingly. The principle of the whole arrangement will be better and more easily understood by reference to the accompanying



SKETCH OF AIRCRAFT CONTROL.

diagram. The telephone transmitter is coupled to the primary current and the receiver to the secondary current. From one of the terminals of the transmitter a wire runs through a suitable resistance, to a switch, hence through a battery, through the primary circuit of an induction coil, to an ordinary post office relay, and from there back to the second terminal of transmitter. The wiring from the receiver is, it will be seen, connected up to the secondary circuit of the induction coil. When the armature of the relay moves over it provides short circuiting by the two wires shown in the diagram running to each side of the secondary coil.

It will now be seen that when the diaphragms of the transmitter and receiver are vibrated by the proper note, determined by the position of the piston in the tube, and no other note will cause them to vibrate, the relay is brought into play and closes the local current which may then be used, via suitable means, of course, for starting or stopping an engine, operating control surfaces, releasing bombs, etc.

In the model framework of a dirigible on which the principle of distant control was demonstrated, there were, as we have already indicated, three small electromotors, each driving a propeller. As demonstrated the sequence of operation of the three motors was, in fact, predetermined by reason of the multiple switch employed for throwing them into gear, the same note being used for initiating the control of all the motors. When rigged up for actual use on aircraft each motor and movement would have its particular note, so that no fixed sequence would have to be followed. Thus, for instance, one note would correspond to right rudder, one to left rudder; one to elevating, one to depressing; one to accelerating the engine, and one to throttling it down. In this way any evolution of an aircraft could be controlled from the ground, the necessary notes being produced by some suitable instrument, as, for instance, a siren, in which the note could be altered by varying the speed of the siren. Care would, of course, have to be taken that no note likely to be produced on board the aircraft itself, either by the engines or by the bracing wires humming in the current of air, was employed for control. In fact, there seems to be no reason why notes of such a pitch as to be inaudible to the human ear should not be employed.

On the model demonstrated it was possible to set the machinery in motion by running up and down the scale until the right note was found. The inventor claims, however, that it would be a very simple matter to arrange a combination whereby it would be necessary to sound the given note, not once but several times, with predetermined intervals, before the result was obtained, thus providing in effect an equivalent to the combinations used on safes, and absolutely preventing outside interference. It is mainly in this respect, we understand, that the inventor claims superiority of the resonance method over the wireless system, in which latter a coherer must be used, and which is therefore open to the criticism that it may comparatively easily be interfered with.

As regards the practical utility of this very ingenious device to aircraft work, the number of forms this might take appears to be legion, and although many difficulties suggest themselves, doubtless they can be overcome. Even if they cannot, that does not detract in the least from the ingeniousness of the device. The inventor has, as already mentioned, ample scope for the application of the device to other fields of engineering. Thus, for instance, for telegraphic purposes the resonator renders possible the sending of a great number of telegrams over one wire simultaneously, with the further advantage that "tapping" the wire can be made practically impossible. Communication can be maintained between a central station and each of a number of trains, thus minimizing the danger of collision, and there are numerous other applications possible. which we cannot deal with here

SAFE AIR-COMPRESSOR OPERATION

BY. M. A. SALLER

In connection with the installation and operation of air-compressing equipment, there are many factors and considerations that may be overlooked or neglected, and thereby result in extreme hazard to the operators, to say nothing of unsatisfactory operation and poor economy.

Probably the first and most important consideration is the compressor itself. The capacity of the equipment should be adequate to meet the requirements for air at the proper pressure and at normal operating speeds. Extreme overloading results in too high piston speeds, and dangerous velocities through the air valves cause inefficient results and present a source of positive danger. A piston travel of 500 ft. per minute, while maintaining full capacity and pressure, should not be exceeded.

Excessive piston speed is often caused by leaky valves and pipe connections, which throw an excessive and unnecessary burden on the compressor. A leak in an air line is just as worthy of attention as a leak in a steam line; therefore frequent inspections should be made to see that they are tight.

The question of flywheel speed should also be given consideration. This is even more important than in ordinary engine work, because of the tremendous strain and high overloads to which compressor flywheels are subjected, owing to frequent and sudden load changes. With a cast-iron one-piece flywheel, a peripheral speed of 5000 ft. per min. should never be exceeded. If the flywheel is of light construction, a speed of 3000 ft. per min. should be the maximum. If the flywheel is made up of flanged sections bolted together, the speed limit should be reduced even further according to the known or calculated strength of the joint construction. In figuring these speeds, the determining factor is the maximum speed of the flywheel when acting under the impulse of the most sudden change of load.

Because of fluctuating and sudden changing of load imposed on a compressor, setting up severe shocks and jars, care should be exercised in locating and building the foundation, which should be of concrete wherever possible in order to minimize the strains on the equipment itself and to prevent, as much as possible, the transmission of jar and vibration to the building.

Another source of considerable trouble and loss of efficiency is in connection with the condition of the air supplied to the compressors. The air intake should be located where dust and grit are not prevalent. Consideration should also be given to the temperature of the air available, since the cooler the air the less heat will be generated in the compressor. Where dust in the air intake cannot be avoided, arrangements should be made to filter the air through a muslin screen before it is delivered to the compressor intake, or else air-washing apparatus should be installed.

All air pipes in connection with compressing units should be designed with as much care and intelligence as are high-pressure steam lines, both as to capacity and the elimination of avoidable sharp turns. This is to prevent any excessive drop in pressure because of undue resistance in the pipe line, and also to minimize as much as possible vibration or pulsation. Air piping should also be arranged and drained to avoid pockets in which water can accumulate.

AIR-LINE TEMPERATURE

The range of temperature in air lines is frequently very considerable because of varying pressures and compression conditions. The piping should be arranged with provision for the free expansion of all parts, otherwise excessive strains, possibly resulting in rupture, may be placed on different fittings or on the compressor itself.

In steam-driven compressors the rush of live steam into the steam cylinder in response to the sudden changes in load is sometimes dangerous because of the liability of pulling over slugs of water. It is desirable to place a steam separator on the steam line to every unit, both from the standpoint of safety and to assist in securing the best lubrication at the minimum expense for oil, as the elimination of the water in the steam prevents washing the oil from the cylinder walls.

It is desirable to insulate or cover exposed steam or hot-air piping—the former from an economical standpoint to prevent extreme radiation losses, and the latter to protect the burning of operators who may come in contact with the exposed pipes.

Of utmost importance in connection with

continuously operating or heavy-duty compressors is that of securing a reliable and generous source of cooling water. Failure of the cooling-water supply in the case of a compressor doing heavy duty will cause overheating and the consequent closing down of the apparatus. In order to know that the cooling water is being supplied, it is advisable to install a flow indicator in the cooling-water line, else arrange the overflow from the jacket so that it discharges into an open funnel where the flow is easily seen.

COOLING WATER

The quality of the cooling water is also of importance, because water containing considerable quantities of lime will cause the deposition of scale on the jacket walls, which seriously interferes with the heat exchange and presents a source of expense and trouble when it accumulates to such an extent that it must be removed. Cooling water obviously should not contain acids or other active agents that may cause the corrosion of the jacket lining.

Every air tank, however small, should be fitted with a reliable safety valve set to release at a pressure well within the limits of the strength of the tank and of sufficient size to release all excess air delivered to it, so that there will be no accumulation above the maximum pressure. On large tanks it is advisable to install at least two valves. A drain for drawing off such oil and water as may accumulate should also be provided in the bottom of the tank. It should be opened at regular intervals, from three to five times daily, according to the local conditions.

Explosions due to the spontaneous combustion of explosive gases within the compressor cylinder, pipe line or receiver tank present one of the greatest hazards in compressor operation. The responsibility for these explosions can be traced largely to the use of unsuitable lubricating oil, coupled with unsatisfactory operation.

The intense heat encountered in the compressor cylinder affects lubricating oil differently from the heat encountered in the steam-engine cylinder, where moisture is usually present. The dry condition of the air cylinder results in the burning of the oil into powder-like particles, which deposit on the cylinder walls, discharge valves and in the pipe line. This soot, when properly mixed with air, has great explosive tendencies when brought in contact with intense heat, and hence its accumulation is highly undesirable, as the temperature of the compressor cylinder and parts may suddenly be increased, owing to the failure of the cooling water, the clogging of the valve passages because of the soot itself, or the extreme overloading of the compressor.

This accumulation of carbon or soot is either the result of feeding excessive quantities of oil or of the use of a poor quality oil. The oil used in lubricating air-compressor cylinders should be of mineral derivation and should be free of all foreign matter, such as tar, which may tend toward the production of excessive carbon deposits. The oil should also be one with a high flash point; that is, one that will not ignite below 500 deg. The ordinary cylinder oil used in steam engines is not suitable for lubricating air cylinders, and a special grade of oil compounded for the service should be used.

DANGER FROM OIL

As there is a positive danger from feeding too much oil to an air compressor, pains should be taken to see that oil is fed at a uniform rate in just sufficient quantities to give the necessary lubrication. A drop or two of oil every five or seven minutes should be ample for the average machine. A record should be kept of the total amount of oil fed to the compressor each week, so that the feeding of any excess can be checked up.

It is advisable to inspect the cylinder, valves and piping whenever possible—and this should not be at longer intervals than two weeks—and any deposit of carbon and soot should be removed by mechanical means; that is, by scraping or cutting away, or by the application of soapy water or a solution of caustic soda and water. Kerosene or gasoline should never be used for removing carbon.

In connection with inspection work it should be remembered that whenever an air-compressor head is being removed care should be exercised in avoiding contact of the escaping gases with a flame, caused by the mixture of the air and vaporized oil, because a flare-up or explosion is liable to occur if the gas happens to be very dense. In all cases where repairs are being made or inspections carried out, the compressor should be allowed to stand for a while to insure thorough cooling of all parts before the work is undertaken.

An aftercooler is used in the air-discharge line for cooling the air after compression, so that any moisture or oil contained therein will be condensed and separated from the air instead of being carried to the pipe line.

Frequently a fusible plug, containing a mixture that will melt at a certain predetermined temperature, is placed in the discharge valves. When the temperature rises above the predetermined point, the fusible metal is melted and the air is discharged with a whistling noise, which sounds the alarm that the temperature is rising and hence the valves or cooling water need attention. Recording thermometers installed in the air-discharge line also serve to give notice of undue rise in temperature in that they will indicate when there is a gradual increase in the temperature of the discharged air.

As pointed out, there are many factors in air-compressor operation that require careful and constant care and attention in order to secure efficient results and to prevent dangerous accidents, and the subject should therefore be considered in all its phases wherever apparatus of this kind is installed and placed in service.—*Power.*

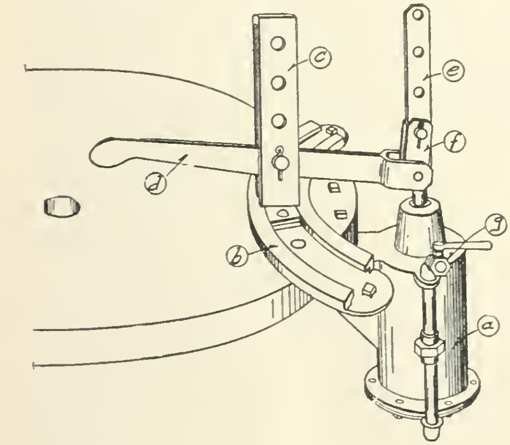


FIG. 1.

PNEUMATIC CLAMPING DEVICES

The handiness of compressed air is probably nowhere quite so highly appreciated as in railroad shops, and devices for its employment originate there so numerously that only a few of them get public mention. The clamping devices shown in the accompanying cuts require little explanation, their construction and operation being self evident.

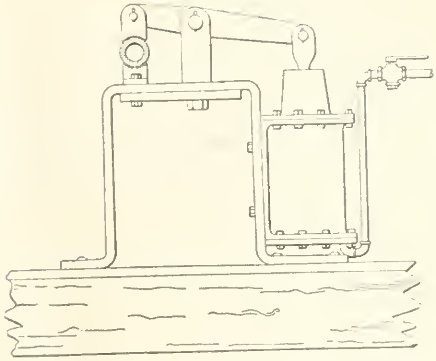


FIG. 2.

Fig. 1, by F. P. Maize, M. M., Portland Ry., Lt. and Power Co., is for clamping work on a drill press table. Using bolts or even screw clamps for the purpose of secure and satisfactory clamping of the work might often take as much time as the drilling, but with the air clamp we might say it takes no time at all. The air cylinder is set alongside of the drill press and as its working pressure is always downward it only requires a level place to stand upon and no bolting. Admitting the air under the piston throws the outer end of the lever down upon the work with the force required to hold it there securely. The lever pins can be changed to the different holes for different heights of work, and the lever can also be swung sidewise as may be required.

Fig. 2 is a pipe vise or clamp which requires no explanation. It is naturally a fixture and can be located where most convenient. It is used as shown in shops of the Illinois Central Railroad, the cut from *Railroad and Locomotive Engineering.*

Fig. 3, from *Railway Mechanical Engineer,* is a chuck for a bolt threading machine used in the Reading shops of P. & R. The body of the chuck is clamped in the jaws of the

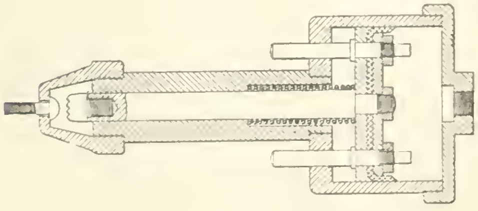
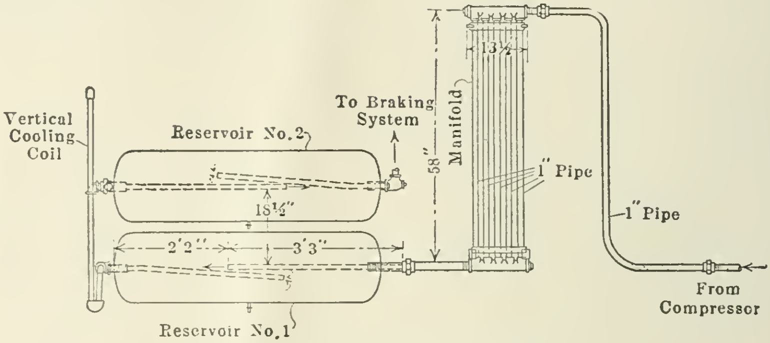


FIG. 3.

machine and the rear of the cylinder is connected to the nearest supply of compressed air. It is used as here shown for short size countersunk or button headed bolts. These are inserted or removed through an opening in the side of the cap and different caps are provided for different sizes or shapes of bolts. When the air pressure is released the springs push the piston back.



AFTERCOOLER FOR AIR BRAKE SERVICE.

AFTERCOOLER AND SEPARATOR IN AIR BRAKE SERVICE

BY J. J. SINCLAIR*

Each winter season brings out different methods of preventing the freezing of the water which condenses in the pipes of air-brake systems of cars. Since most of the moisture will condense where the cooling of the air takes place, it is essential to provide a means of removing this suspended water from the pipes before it is carried through into the air-brake system proper. The diagram shown herewith illustrates how this has been accomplished on the subway cars of the New York Municipal Railway.

The air coming from the compressor passes through the manifold which consists of five 1-in. pipes connected in parallel between headers. As the air is cooled in the manifold the moisture condenses and is carried along suspended in the air until it reaches the first main reservoir. It will be noticed that the incoming pipe is extended to within 2 ft. 2 in. of the end of the reservoir, which thereby acts as a baffle and removes much of the suspended water. This falls to the bottom of the reservoir, where it is drained off. The outgoing pipe extends beyond the end of the incoming pipe, thus providing for good circulation of air in the reservoir. The air passes from the first reservoir to the vertical cooling coil. More of the remaining moisture will condense here and be carried into the second main reservoir, where it is removed as in the first one.

This scheme has worked out in a satisfactory manner during the past winter and is one that could readily be applied to any air-brake system.—*Electric Railway Journal.*

FRENCH COAL MINES IN THE WAR

Lens and Lievin, which have just been captured by the British, after a German occupation of over two years, are very important, because of their mineral wealth. Lens has a population of about 30,000, but if the surrounding villages be added the number exceeds 40,000. Lievin alone has a population of 25,000. Lens was the scene of some fierce fighting during 1915, particularly at Loos and Hulluch, on the British flank, and Notre Dame de Lorette and Suchez on the French flank. Lens has been compared to Wigan, as the centre of a great coalfield. At Lievin 4,000 men were employed before the war, and the annual output of coal was 1,000,000 tons. The Lens mines, as a whole, before the war had an annual output of about 5,000,000 tons. The mines have been ruthlessly destroyed by the Huns on a systematic scale of devastation, which it took a fortnight to carry out. M. Reumaux, a director of the Lens mine, says it may be possible to recommence working in eight months, but more probably a year will be required to put the pits in order.

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*Assistant Engineer of Car Equipment, New York Municipal Railway, Brooklyn, N. Y.

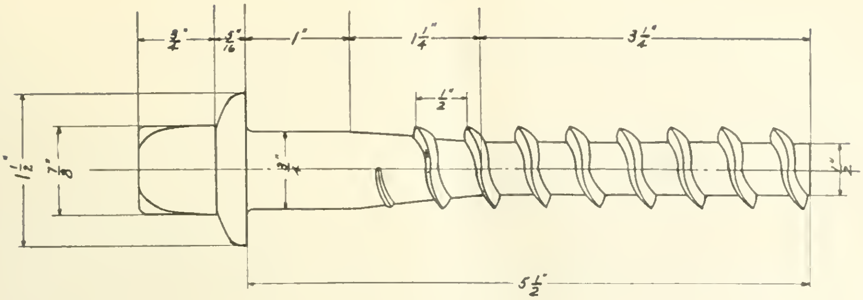


FIG. 1.

DRIVING SCREW SPIKES ON NEW YORK CONNECTING RAILROAD

BY H. L. HICKS

The New York Connecting Railroad linking the New York, New Haven and Hartford and Pennsylvania Railroad systems via the recently completed Hell Gate Bridge was recently opened for passenger traffic, work having been rushed for several weeks in laying the double track over which the trains were to run.

Particular interest attaches to the use of screw spikes to anchor the 125 pound rails. These spikes are of two types, one to hold the tie plates, (employed throughout) and a larger size for the rail itself. The first, Fig. 1, is about 6 inches long by ¾ inch diameter, the second, Fig. 2, is about 7⅝ inches long by ⅞ inch diameter and has a flange to grip the rail. Both have a heavy thread of ½ inch pitch and ⅞ inch square heads. Six spikes are used at each end of a tie, four for the tie plate and two for the rail.

These spikes are being driven pneumatically with highly satisfactory results. This class of work requires a machine readily handled and possessing exceptional power. The "Little David" No. 11 SE Reversible Drills Fig. 3, which are being used meet the conditions admirably. These tools have been fitted with a special driving socket which fits the spike heads. This has been made as short as possible, which makes the machine better balanced and more easily placed on the spike heads. The No. 11SE Drill is compound geared, weighs 70 pounds and operates at a speed of 100 R. P. M., consuming about 55 cu. ft. of air. The writer's observation of the time required for driving a single spike was an average of 5 seconds for the smaller spikes and an average of 6 seconds for the large ones. Under favorable conditions the six spikes in one end of a tie can be driven in about 45 seconds. No lubricant is used, unless the creosote with which the ties are treated can be so considered.

Ties are bored with ⅝ inch holes for tie plate spikes and ⅞ inch holes for rail spikes

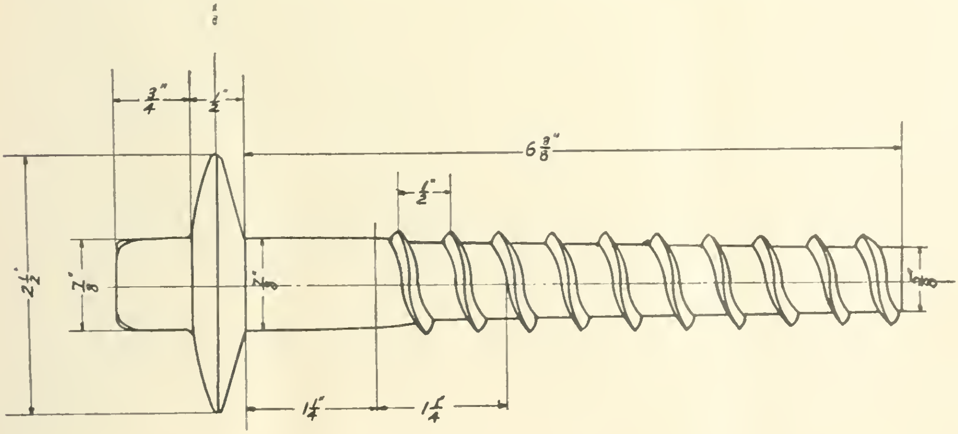


FIG. 2.

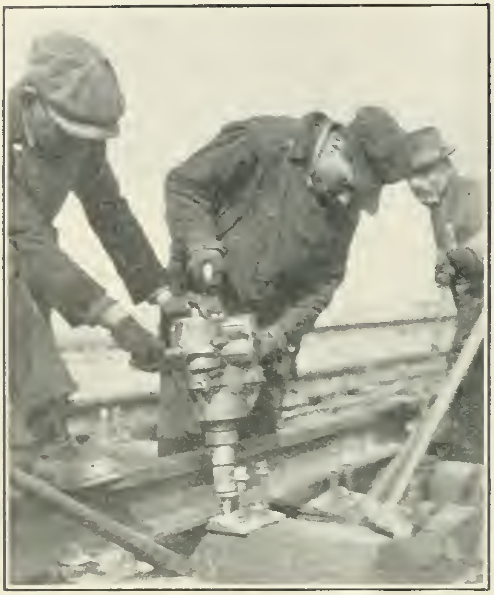


FIG. 3.

before being laid, but there are instances where the holes will not register with the tie plates and, as no tie plates are used at the rail joints, the spike holes for the fish plates also must be bored on the job. This work is done by "Little David" No. 13A Wood Boring Machines Fig. 4, about 10 seconds being required to bore a 5/8 inch hole through a tie.

Compressed air at 100 pounds pressure is supplied by two "Imperial" Type XII Gasoline Driven Portable Compressors, Fig. 5. These are duplex vertical compressors with cylinders 8 in. in diameter by 6 in. stroke, short belt driven by four-cylinder, tractor type gasoline motors. A cone clutch permits the load to be released when starting the motor. Each weighs about 5,600 pounds and has a rated piston displacement of 140 cu. ft. per minute. It is of interest to note that these machines, of the manufacturers standard road portable type, have been adapted to track work by the simple expedient of temporarily bolting a circular flanged piece to the rim of each wheel. Each compressor supplies air to two spike driving machines, one for each rail, and to the wood boring machine serving both. The compressors are operated about 100 feet apart and are easily moved by two or three men as the work progresses.

The labor required is as follows: an operator for each compressor, two men with wood boring machines and four gangs of five men, each gang consisting of two men to operate the "Little David," two men with crowbars and one with sledge to line up the ties and to hold them while the spikes are being run in. This is necessary because the air drills are so powerful that they slightly turn the tie as soon as the spike is solidly seated unless the tie is firmly held.

Ties, tie plates and rails are laid in advance of the spiking gang and all rail joints are completed. Much of the gang's time is devoted to straightening the ties and registering the spike holes with the rails. The average progress per 10 hour day has been twenty 33 foot rails with each compressor unit. At 20 ties per rail and 12 spikes per tie this totals 4,800 spikes, or 9,600 spikes for the two outfits.

The operating costs per day (10 hours) are approximately as follows:—

40 gallons gasoline at 23c	$9.20
1 gallon lubricating oil at 60c	.60
2 compressor operators at $3.50 and $3.00 per 9 hours	7.22
8 spike driving machine operators $2.75 per 9 hours	24.44
14 laborers at $2.50 per 9 hours	38.89
Miscellaneous supplies	1.00
	$81.45
Cost per spike	0.008

No charges have been made for depreciation or overhead expense. The item of compressor repairs has been omitted, based on the operator's report that there were no shutdowns or repairs necessary in running a month and a half.

Comparative costs of hand work, as compared with the above figures, are not available, principally because the use of screw spikes is generally held to be impracticable without a reliable means for mechanically driving them.

The contractor for the track laying was P McManus Inc., Mr. E. J. Horan, Supt. The compressors and pneumatic equipment are manufactured by the Ingersoll-Rand Company, New York.

FIG. 4.

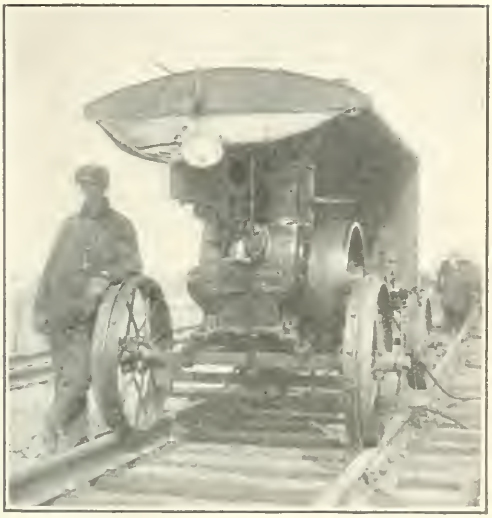


FIG. 5.

COMMON SENSE ON THE METRIC SYSTEM

The following is from an unidentified correspondent, W. A., of *The Engineer*, London, and maintains the English local viewpoint all through. This being remembered, it should be entirely intelligible to our readers, and should be equally appreciated here.

In this controversy over units of measure the one point that should be prominent is usually ignored, I mean the convenience and custom of the users. There are about 530 million users of the British system, 300 million of the metric, *i. e.*, a ratio of 1.75 addicted to the foot and the pound. The balance of the world's population is 770 million, the majority of whom are as yet indifferent. These figures cannot make pretence to accuracy, but they give an idea of the proportion among the users.

The metric system has been optional and legal in this country for the past twenty years. As we cannot point to a large turnover to the metric system, we are bound to suppose that the folk who would make it compulsory must be determined to do us good against our wishes. Those who have adopted it have been for the most part persons engaged in research work, to whom undeniably, the convenience of a universal system is great. There are also a few engineering firms, mostly of continental origin, or directed by foreigners, who have brought with them a bias for the system to which they have been accustomed, just as we have a bias for the one we use.

Whilst dealing with the more general aspect of the question it should be noted that, at the time when France, Germany, and the Latin races adopted the metric system, they were hardly great manufacturers, whatever they may have become since. The users of the British system, who conjointly are the greatest manufacturers in the world, are to be confronted with a change of system in their present highly organized state,—a very different proposition to that which was faced by the nations who joined the metric league.

If the convenience of the user is the main issue, I think the advocates of metric compulsion should show much stronger reasons for the change than they have advanced hitherto. The metric system is largely urged on us by scientific men because they deal with a vast variety of substances and qualities. The metric system and its developments has offered the best solution of their requirements, so far. But it should be noted that it is *their* convenience that is the deciding factor. The man engaged on research having found its advantages, presupposes that the same advantages would accrue to the cheesemonger, the tailor, the engineer, the printer, etc., and urges its compulsory adoption. I venture to think that this is a great error. The ordinary man of business, or workman, generally has a very limited number of materials and qualities to deal with. Beyond representing the specific gravity of a substance and its density by the same number, I cannot see much gain to the vast body of the community. Moreover, the numbers for these qualities are equally difficult to remember in any system.

The virtues, if any, to be obtained by a decimal system cannot, of course, be claimed for metric measures—it is a system open to any weights and measures. With the exception of our ten "pickers and stealers," the remainder of the realm of Nature seems adverse to the decimal system. A cow or a milkmaid constructed on the decimal system would be a curiosity, for which nations would contend! We must therefore come to the conclusion that the advantage of the metric methods lies in the absolute values of the units selected. It comes to this, then, we, the majority, are requested to bear all the expense and inconvenience of changing our yard for a measure about 3⅓ in. longer, and our standard of weight for one which is just a little more than double! It seems to me an abjectly preposterous proposition.

Systems of weights and measures must be adapted to the requirements and conveniences of the user. Look, for example, at the units of length which the metric system itself has developed—

Tenth metre	= 10^{-10}	metre
1 μμ or millimicron	= 10^{-9}	,,
1 μ or micron..	= 10^{-6}	,,
Millimetre	= 10^{-3}	,,
Centimetre	= 10^{-2}	,,
Decimetre	= 10^{-1}	,,
Metre..	= 1	,,
Decametre	= 10	,,
Hectometre	= 10^{2}	,,
Kilometre..	= 10^{3}	,,

No less than ten values.

From my knowledge of children, I know that to connect these names with the various plus and minus powers of ten would be at least equally confusing as the statement that 12 in. make one foot, 3 ft. one yard, etc. Scientists have added a further unit called a "light year," solely for the reason of convenience.

There is considerable difficulty in defending the various national measures, because they have grown up with the life of the nation. All such relationships which are complex—the franchise, monogamous marriage, etc.—are difficult to defend against a show of misleading simplicity. One of the best tests is convenience to the user. I reiterate this. If in a hilly country like Switzerland, you ask how far it is to the village you are walking to, you will receive your answer in hours. It is absolutely indefensible from the scientific point of view, and is, indeed, open to ridicule, but it is much more convenient than miles or kilometres under the circumstances.

What becomes of the vaunted simplicity in the case of a farmer who wants so many cwt. of "artificial" to the acre, or so many kilos, per hectare? Let us suppose the metric figures are always the simplest. The fertilizer refuses to maintain a metric purity, so, when buying, the farmer must divide by some figure lying between .55 and .95 and, to adapt Kipling, as the vanishing zebra said to the Ethiopian "One—two—three—and where's your simplicity?" Will that convenient measure, the drop, become illegal? How was it the French Directory failed to enforce its months, or its circle divided into 400 degrees? For a terribly vulgar reason—because it wasn't worth it. Why is so much spoken in praise of the thermometer that is divided with 100 parts between freezing and boiling points, over that divided into 180 parts? Nearly all phenomena are best referred to absolute values of temperature. In the former case, 273 deg. have to be added. Is there some magic value in 273 over the 469 required in the Fahrenheit scale.

Our own British system is much maligned, due largely to the makers of elementary arithmetic books. These worthies seek outrageous conversions for the confusion of the minds they are supposed to educate. Much of the ridicule cast on the British system by metricists arises from ignorance. The coal merchant deals in tons, and should he ever require to deal in grains, he can find the information ready to hand in Whitaker, just as I am sure a draper who dealt in metres would go to a "table" to find out the value of a micron. To enjoy the company of the Progressives it is necessary to over-rate the value of ten as a factor. The ancient Greeks, who were practical as well as intellectual, knew that the mind worked in ratios, or proportions, consequently they selected, where practicable, such multiples as 12, 24, 360, etc.

Even in such cases as fitting where the goodness is measured more by differences than ratios, the work is not hampered, because the unit has a large and convenient number of factors.

Before the war we had fits of nerves, and got the idea that anything but what we have must be an improvement. Are we not in the same way over this metric business? We are proposing to burden the English speaking race with a tax that will, I suppose, reach 100 million sterling. For whose good? And all this to be done to substitute for a yard of 36 in. a length called a metre, which is 39.37 in., and which possesses the unique merit of being 10^{-7} part of an earth quadrant inaccurately measured, and subject to variation with time.

When faced with a proposition of such vast import it savours of fraudulence to mix up with a decimal system. Anyone is at liberty to decimalize the yard or the foot or pound or anything else. Indeed, it is frequent in certain classes of work.

So far as education is concerned, it is vapid to talk about the ease of multiplying by ten. We do not always require either ten times our unit, or a tenth of it, and I would further suggest that it is quite as essential for a child to learn to multiply and divide by 2, 3, 4, 5, 6, 7, 8, and 9 as well as by ten. If we must have a change let us at least choose a sounder basis than the metric, and let us all begin on it alike, so that all start with a level handicap.

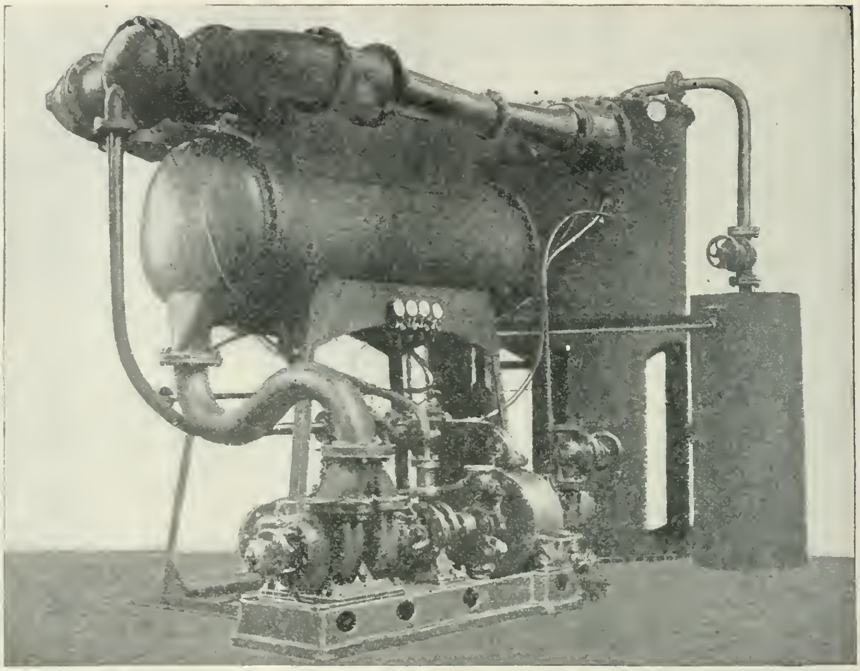
TWO BABY HOISTS RUN A DISABLED DERRICK

BY H. L. HICKS

Two little tugger portable air hoists were substituted recently for the regular swinging gear used to operate a large quarry derrick in Vermont while the regular engine was being repaired. As the derrick—the largest of those in use—was important to continuous operation, the quarry was practically tied up by an accident to its swinger. The superintendent, however, quickly improvised a new swinging gear by bolting the two "little tuggers" side by side to 2-in. planks, which in turn were changed to two large blocks of granite, as shown in the photograph. The lines from the hoists were led to opposite sides of the bullwheel, one being used to turn the derrick in one direction and the other to swing it back. This improvised arrangement kept the derrick in operation more than a week while the regular swinging engine was being repaired. In ordinary service one of these little hoists is used to overhaul the heavy cable from one of the derricks across the quarry pit, while the other is used in lowering steels and light loads into the pits.

The rig described was used in the Montpelier (Vt.) quarry of the Wetmore & Morse Granite Company.

The wide usefulness of first aid training in and about the collieries of the anthracite field is illustrated in the announcement that men who have received this training are to take steps looking to the formation of a hospital corps which may be very much needed in the present war.



LEBLANC REFRIGERATING MACHINE FOR LOW BRINE TEMPERATURE USING A SURFACE CONDENSER AND TURBINE DRIVEN PUMPS.

REFRIGERATION BY VACUUM PROCESS AND WITHOUT GAS COMPRESSION

BY WILLIAM H. EASTON.

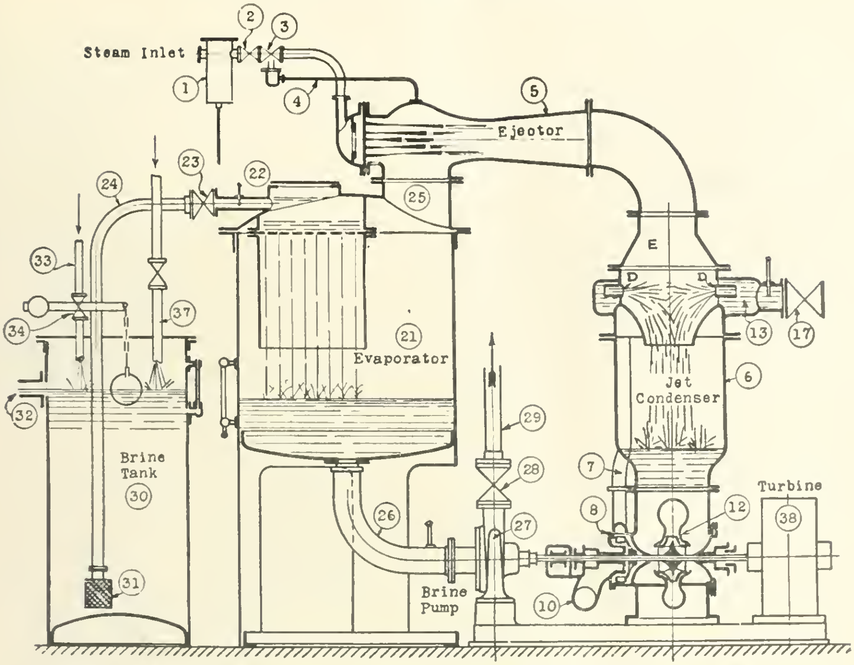
So general is the use of a compressed gas of some kind, such as ammonia, carbon dioxide, etc., for mechanical refrigeration, that a machine that operates with neither a gas of this sort nor under high pressures is regarded as almost a curiosity. For this reason, the newly developed Westinghouse Leblanc refrigerating machine has awakened considerable interest.

The actual refrigerating element in this machine is simply a brine solution, (or even pure water where temperatures below freezing are not wanted) and the principle it employs has literally been used for cooling from time immemorial. Briefly, this principle is as follows:

Everyone knows that the evaporation of water produces a cooling effect, and that if water is rapidly evaporated in a high vacuumn the cooling will be so intense that part of the water will freeze. Now referring to the diagram, Fig. 2, 30 is a reservoir containing the brine solution; 21 a large tank called the evaporator; 6 a condenser; and 8 an air pump. By means of the air pump the whole system beyond valve 23 is kept at a high vacuum. It is evident, therefore, that by opening valve 23 the brine solution will be drawn into the evaporator. Here it passes through a sieve and falls as a fine spray.

As the vacuum in the evaporator is high, a large part of this spray is evaporated, and in the act of evaporation, it absorbs a great deal of heat. There is only one source for this heat, however, and that is that part of the spray which does not evaporate. This portion, then, falls to the bottom at a low temperature, is drawn off by pump 27, is distributed whereever wanted for ice making or refrigerating purposes, and returned to reservoir 30.

Of course the vapors formed in the evaporator would soon reduce the vacuum and check the process, so they must be promptly removed. They rise in pipe 25, and here they meet a steam jet from an ejector, which sweeps them into the condenser where both vapors and steam are condensed. The condenser shown is of the jet type, but any other kind may be

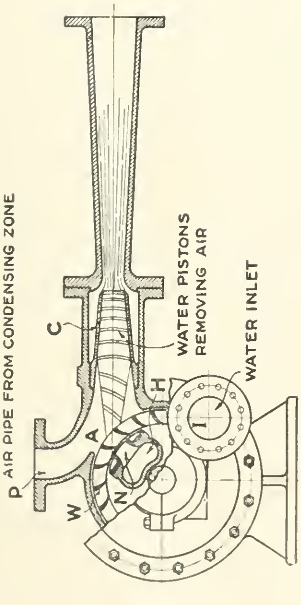


DIAGRAMMATIC ARRANGEMENT OF WESTINGHOUSE-LEBLANC REFRIGERATING MACHINE.

used, surface condensers being necessary on ship board.

The efficiency of the process depends on the maintenance of a high vacuum, and though attempts have been made in the past to utilize this simple principle they failed for want of an effective air pump. Hence the success of this machine can be largely credited to the Leblanc air pump, No. 8. An enlarged diagram of this pump is shown in Fig. 3. It is similar to an ordinary centrifugal pump in construction but has two inlets, one for water and one for air. The water discharges through the outlet, and in doing so carries the air along with it by the formation of pistons, similar to the action of the well known mercury pump. As there is no air leakage back into the system there is no difficulty in maintaining the necessary high vacuum.

The absence of a gas at a high pressure evidently eliminates all danger from explosion or gas leakage. Nor are any of the essential materials—water, salt, and steam—difficult to obtain in any part of the world, which is a matter of importance to a ship at sea. The size and weight of these machines are about one half of those of compressor machines of similar capacities, and the efficiency of operation is quite as good.



CROSS-SECTIONAL VIEW OF WESTINGHOUSE-LEBLANC AIR PUMP SHOWING PRINCIPLE OF OPERATION.

The shrinkage of manganese steel castings amounts to $^5/_{16}$ inch per foot as against $^3/_{16}$ inch to ¼ inch in ordinary steel foundry practice.

AIR WASHING AND PURIFYING

BY CHARLES L. HUBBARD

Of equal importance with the volume of air supplied to a building is its quality, which is especially true in the case of hospitals, schools, banking rooms and industrial plants. The conditioning of air relates to the removal of dust, regulation of the humidity and the cooling of it in summer. When buildings are in crowded localities the air is more or less filled with soot and street dust, especially at certain seasons of the year, and its removal in the instances mentioned is a matter of much importance, both on the score of healthfulness and of cleanliness.

Humidity is an important factor in good ventilation, as too dry an atmosphere produces an irritation or dryness of the respiratory passages, while too much moisture has a depressing effect.

Heating air causes the relative humidity of it to drop rapidly, as this is entirely dependent upon the temperature, and varies in an inverse ratio. The normal humidity of the external atmosphere varies from 40 to 70 per cent. of saturation in this climate, and it is desirable to maintain an inside humidity of 50 to 60 per cent., according to the character of the building. The effect of heating the air without moistening it is illustrated by the following figures:

Temp. of outside air	Relative humidity of outside air	Relative humidity of inside air when heated to 65 degrees
0 deg.	50 per cent.	3.5 per cent.
	70 per cent.	5.0 per cent.
20 deg.	50 per cent.	9.1 per cent.
	70 per cent.	12.7 per cent.
50 deg.	50 per cent.	30.1 per cent.
	70 per cent.	42.0 per cent.

It is evident from these figures that if outside air at a temperature around zero, but having a normal humidity of 50 to 70 per cent., is warmed to 65 degrees, the relative humidity will drop to 3.5 and 5 per cent., respectively, which is dryer than the most arid regions.

Too dry an atmosphere is not only irritating to the air passages, but it produces a feeling of chillness, due to the rapid evaporation from the surface of the body.

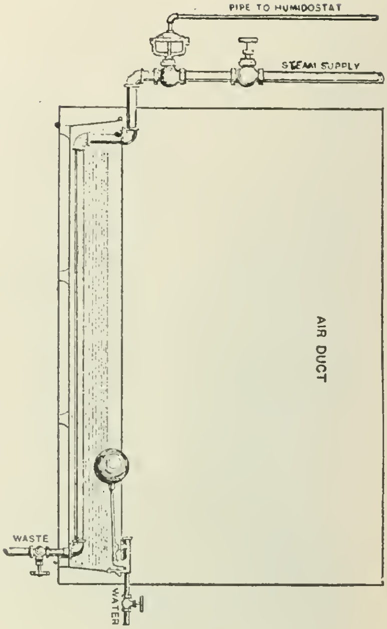


FIG. 1.

Experience shows that a room maintained at 65 degrees and 50 to 55 per cent. relative humidity, feels warmer than a room at 70 to 75 degrees with a humidity of only 30 to 35 per cent.

When a building is located in the open country, or in the outskirts of a town or city where the air is free from dust and soot, filtering may often be dispensed with provided some means is furnished for adding moisture to the entering air. There are different methods of doing this, depending somewhat upon circumstances.

If the temperature of the entering air does not exceed about 70 degrees the humidifier may be placed in the main supply duct.

When steam is available and is clean and odorless, a perforated pipe in the air duct forms a simple method. Sometimes a fine spray of warm water in place of steam is used. When neither steam jet nor water is advisable an evaporating pan forms a good arrangement. This is shown in Fig. 1, where as will be noted, a steam coil is immersed in the water to heat it to the evaporating point. An automatic device called a humidostat, controls the steam supply by means of a diaphragm valve, and the water is kept at a constant level in the pan by using a ball cock.

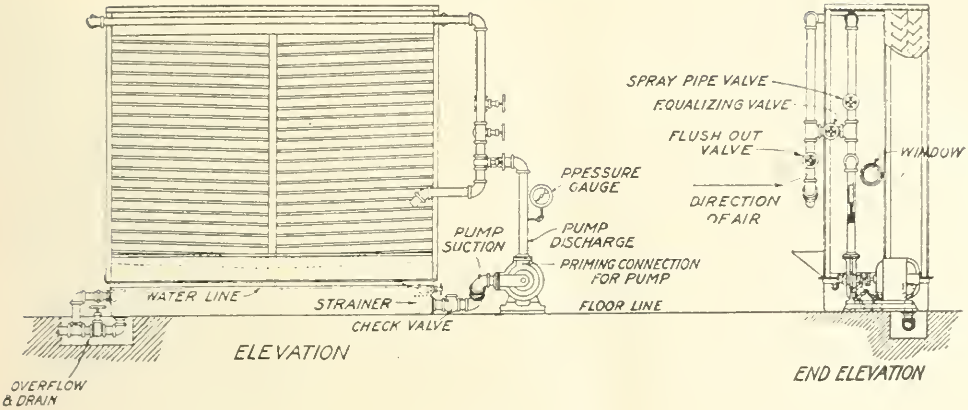


FIG. 2.

When the removal of dust is necessary some form of washer or spray filter gives the best results. A device of this kind is especially useful in this class of work because the removal of dust, regulation of humidity, and cooling of the air in summer, may all be combined in the same apparatus. A typical air washer is shown in plan and elevation in Fig. 2. It consists essentially of a series of spray nozzles for producing a warm curtain; and an eliminator for removing the entrained spray from the air after passing through the curtain. Pressure for producing the spray is furnished by a small centrifugal pump, usually driven by an independent electric motor. The eliminator is made up of a series of specially formed baffle plates inclosed in a metal casing. The spray water falls into a tank below the eliminator and is used repeatedly until the accumulation of dirt makes it necessary to change it.

Air washers are placed between the inlet window and the fan, and also between two heaters, known as tempering and secondary heaters, respectively, the first of these is for raising the temperature of the entering air above the freezing point, and the second for bringing it up to the desired temperature for delivery to the rooms.

A device of this kind is made to serve for the control of humidity by maintaining a proper relation between the temperature of the air entering the spray chamber and the spray water itself, thus regulating the amount of evaporation, which is due entirely to the temperature.

The temperature of the air is regulated by means of the tempering coil, and the water, either by a steam coil or steam and water mixer in the tank beneath the eliminator, all of which are under automatic control.

Standard makes of apparatus of this kind guarantee to maintain at a predetermined room temperature a relative humidity within 5 per cent. above or below that desired, as long as the wet-bulb temperature outside does not exceed the dew point temperature desired in the building.

Air cooling is accomplished by evaporation and is therefore greater with a fine or mist spray. It is evident that the dryer the entering air, the greater will be the evaporation, and, consequently, the greater the cooling effect. A considerable amount of cooling may be obtained by re-circulating the spray water, but will be considerably increased by the use of running water, either from a deep well or city supply.

Relative humidity of outside air	Cooling effect, with spray water at 75 deg.	Cooling effect, with spray water at 55 deg.
40 per cent.	4.5 degs.	13.0 degs.
50 per cent.	4.0 degs.	12.5 degs.
60 per cent.	3.5 degs.	12.0 degs.
70 per cent.	3.0 degs.	11.5 degs.

The above table, based on an outside temperature of 80 degrees, gives the approximate cooling effect for different degrees of humidity, and with spray water at two different temperatures.—*Southern Engineer.*

PNEUMATIC STAGE FURNITURE FOR THE TRENCHES

From an impromptu affair held in the open with the natural setting for the scenery and a number of soldiers for the cast, the soldiers' theatre has developed into a recognized institution. To-day the theatres in the war zone boast of real scenery, a real stage, and very often real players.

With characteristic Teuton thoroughness the Germans have not been slow in adopting the war theatre idea and in developing the mechanical end of it. Their latest progress has been in the direction of special pneumatic stage furniture which, when inflated, takes on the forms of a table, piano, sofa, chairs and so on, according to the requirements of the play. The pressure employed for inflating the furniture is sufficient to make it fairly rigid, so that the effect is highly realistic.

For transportation purposes the pneumatic stage furniture is deflated, whereupon it collapses and can be rolled up into a comparatively small bundle. To simplify matters each pneumatic "prop" or set is made in one piece, the carpet serving to join the various members together.—*Scientific American.*

BY-PRODUCT POTASH

According to U. S. Consul Chester Martin, of Toronto, Canada, a newspaper of that city states that a company making Portland cement at Durham, Ontario, is now turning out as a by-product from the feldspar twelve to sixteen tons of potash daily. Feldspar rock is added to the limestone as a raw material for cement, and a process has been evolved for collecting the liberated potash. Both muriates and caustic products are produced, and while the market standard of the former is fixed at eighty per cent. to the trade, the company claims that it is possible to produce an article which is almost pure.

The cost of manufacturing potash in Canada from feldspar is so low even now that it is less than the freight charge paid on a ton of the imported German products before the war. The result of this discovery will be the complete breaking of the German monopoly. In addition to guaranteeing a much-needed supply of potash for the present urgent demands, it will result in meeting the needs of the American Continent for fertilizers.

UNCLE SAM'S MILLIONS AND UNCLE SAM'S MEN

BY BERTON BRALEY

Cheer up, Tommy Atkins and Johnny Crapaud,
Your road has been weary and bloody, we know;
You've fought through discouragement, sorrow, defeat,
When failure seemed certain and gloom was complete;
But always our hearts and our prayers were with you
And now all our wealth and our power are too;
We've picked up the sword, and we've laid down the pen
And Uncle Sam's coming with millions and men!

Our vessels shall come to you loaded with grain,
So many the U-boats will fight them in vain;
From mills and from shops, from farms and from mines,
Munitions and foodstuffs shall come to your lines;
And soon we shall send, with our steel and our guns,
A million or so of our gallantest sons;
We'll help to bring peace to the world once again
With Uncle Sam's millions and Uncle Sam's men!

We hate all the bloodshed and horror of war,
But freedom and justice are worth fighting for;
And therefore we join with your battle-scarred clan
To make the world safe for the future of man;
Fight on, brother nations, be steadfast of heart,
We're coming to join you and take up our part,
To fight till democracy conquers again
With Uncle Sam's millions and Uncle Sam's men!

—*American Machinist.*

The cement gun was used with success and satisfaction for the cement lining 1¾ inches thick applied with an air pressure of 35 lb. gage, to the interiors of five large steel smoke stacks recently built for the Ford Motor Company, Detroit.

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W. L. SAUNDERS, - - - Editor
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CHAS. A. HIRSCHBERG, Business Manager
W. C. LAROS, - - Circulation Manager

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DROP IT TILL THE WAR IS OVER

It is not to the credit of the advocates of the compulsory adoption of the metric system that they have pounced upon this time so inopportune for the renewed urging of their fad. When the fate of the world for generations is in the balance what matters it whether we are to do our measuring by metres or by yards? It is especially to be wondered at that the pushing of the metric system should be started up with such vigor at this time, since there is no business or pecuniary interest behind it, or any substantial thing apparently to be gained by its successful advocacy.

If there is anything that the metricists, individually or collectively, can claim it is that they are disinterested. They are not working for dollars and cents for themselves but for the good of the world, for the convenience and ultimate benefit of humanity, don't you know? Now, no great thing, such as its advocates assume this to be, is ever accomplished by disinterestedness. Disinterested workers can show but one dependable product. They are the world's mischief makers, and the most that can be expected when the trouble is over is change without improvement. The metric system involves many changes and possibly some improvements, but it brings with it also inherent inconveniences of its own which cannot be eliminated. The universal adoption of it would certainly not be final. Some clearer sighted innovaters, who even now are sufficiently in evidence, would be as clamorous as the metricists are now for another and perhaps a more revolutionary change. If any one will look into it, a system of duodecimal notation, with unlimited subdivisions by twos and threes, and using the yard and the quarter inch as basic units, would be vastly more convenient and more easily reconcilable with existing standards.

The opposition to the compulsory adoption of the system is in essential character as far as possible from the sentimental metric propaganda. There is no possibility of pretended disinterestedness there. There is call for strenuous action in defense. Not only are inconvenience and confusion involved in the proposed change, but enormous expense would be involved. This expense would not be in manufacturing operations but in the changes in tools, gages, and machinery involved. This would not be in these things merely the changing of the new for the old, the replacing of the one by the other, but the continued maintenance of both almost without limit of time.

All this has been argued over and over, and it is useless to try to push it farther, but it might be worth while to try to imagine what would occur, for instance, in the Navy of the United States if Congress in its boundless wisdom should make the proposed change imperative. We need not say anything of the armament but think only of the machinery. Everything up to now, and without any planning, has been built to the old standards. The engines, generators, motors, pumps and auxiliary apparatus, are composed of innumerable details and all these details are interchangeable and would fit in their respective places not only all through each ship, but from ship to ship all through any fleet or the entire navy. This applies to bolts, nuts, screws, pins, rivets, pipes, pipe-fittings, valves, etc.

Now, suppose that all our ships from any given date, not remote, are built to metric measurements. These in detail, we may assume, would have the same interchangeability as in the older ships, but the ships old and new would have no interchangeability of parts from one to the other; and so for the maintenance of the ships and the replacement of parts, for repairs or otherwise, it would be necessary to carry a complete stock of both metric and non-metric parts and to maintain indefinitely the machinery and tools for the manufacture of each.

This is only a slight suggestion of the additional complications involved, to say nothing of the misunderstandings and mistakes in making and supplying which would inevitably become more frequent. We might show troubles of the same kind through all the details of our naval equipment, through army material and the merchant service. We could not suggest any line of human activity which has to do with the doing of things material which would not be inconvenienced. And all for what? We can well afford to wait for an adequate and satisfactory answer until the war is over.

For opposition to the metric agitation at the present time, saying nothing of the intrinsic merits of the case, there is ample justification; for its persistent advocacy there is none.

INTERCOOLER EFFICIENCIES

[The following correspondence, reproduced from *Practical Engineer,* May 15, refers to an article with the above title in the April issue of Compressed Air Magazine, which article also was first printed in *Practical Engineer.* In the editing of the letter of Mr. Richards for the dignified columns of *Practical Engineer,* a few of its sentences disappeared; the letter is here presented precisely as originally written]:

Dear Sir:—I have read with careful consideration the article in the Mar. 15 issue of *Practical Engineer,* by Frank Richards, on Intercooler Efficiencies, in which he says it will not increase the volumetric efficiency, or reduce the horsepower required to operate an air compressor, to remove the moisture or water from the air passing through the intercooler.

I beg to take exception to his view and give one experience I had along this line, while I was employed as superintendent of a large manufacturing plant in the West, a position I held for over 30 years.

In 1912, our firm secured a contract to build about 8 miles of 24 and 30-in. steel riveted pipe, No. 5 steel, to stand a working pressure of 125 lb. per square inch. We were under contract to deliver 400 ft. per day. We had a 580-cu. ft. two-stage air compressor of a well known make equipped with the Standard intercooler.

When we started work on our pipe line, we were running the compressor at its catalog speed of 160 r. p. m. using a 150-hp. General Electric motor. Our voltage was high, but our motor ran hot, and showed plainly that we were using all its power. We broke two-cylinder heads on the low-pressure side and it was all we could do to keep the compressor in running order, and we could get air enough even at 80 lb. pressure to operate but little over one-half of the equipment required to make the 400 ft. of pipe per day.

I tried forcing more water through the intercooler; this helped matters as far as cooling the air to a lower temperature was concerned, but did not give us enough air to help us keep up the pressure we wanted. We were just about to do what many others have done when they found they were short of air, that is, buy another compressor, when the writer decided to build an intercooler, with the view of removing the water from the air before it reached the high-pressure cylinder.

We never got any water from the old intercooler; but when we got the new one in operation there was a constant stream of water running from it and our air troubles were over. We could carry 100 lb. pressure, had air enough to operate our entire equipment, even after we reduced the speed of the compressor from 160 r.p.m to 130 r.p.m., removed the 150-hp. motor ant put in an old type 75-hp. L frame General Electric motor which our tests showed was developing about 85-hp.

We were about 5 months on this pipe line and never stopped one minute through the day on account of air or compressor troubles.

In view of the above facts, I am forced to the conclusion that an intercooler to be efficient must not only cool the air but remove the water from the air before it enters the high-pressure cylinder of the compressor. Now, if, as Mr. Richards says, the removal of 75 per cent. of the water will only increase the volumetric efficiency of the compressor, ½ of 1 per cent. and only reduce the power required to operate the compressor 1 per cent., I would like to have him or some other compressed air expert tell me how I got the results we got at the Union Iron Works by simply removing the water.

H. E. MacCamy.

Dear Sir:—I was very glad to receive a copy of Mr. MacCamy's interesting letter and to be given an opportunity immediately to reply. Mr. MacCamy is to be regarded as a compressed air missionary—of a certain kind—in that he is doing such effective work in provoking the users of compressed air to investigate the economical possibilities.

The idiosyncrasy of Mr. MacCamy seems to be to overdo the intercooler. Now, the intercooler is not the whole thing in air compression. Years ago many air compressors were used without intercoolers, but, in spite of all his efforts, Mr. MacCamy will never see the day when intercoolers will be used without air compressors.

I decline absolutely to discuss Mr. Mac Camy's narrative of the installation of his first intercooler, and I especially repudiate his attributing to it the alleged results accomplished. I do not question the truth of the story. In fact as it stands it tells too much truth, although there is a complete absence of all precise data which could be subjected to computation or comparison. We do know in a general way that here was a compressor installation running under unimaginably bad conditions and consequently inadequate for the service required of it. The electric motor was so hopelessly bad that it had to be thrown out entirely. What other reason could there have been for throwing it out? Of course a smaller motor that would work must have been better than a larger one that would not work.

Besides the motor, the air compressor itself was in such a bad condition, he tells us, that in running it two cylinder heads had been knocked out. Now, what had the presence or absence of an intercooler, good or bad, to do with that, or how could any intercooler have a retroactive effect, baleful or beneficient, upon what might be going on in the low pressure air cylinder? After the defective motor had been replaced and the compressor overhauled with the addition of a new intercooler things worked much better than before. Nevertheless it may be proper to warn Mr. MacCamy that if he ever states in his advertising reading matter that his intercooler will prevent the breaking of cylinder heads in the low pressure cylinder, I shall consider it my duty to post a public protest. Those who can be allured by argument of this style are in sore need of protection.

As to the effect of any intercooler, however perfect, upon the volumetric efficiency of a two-stage compressor, I have not much to say, and I am very content to leave that to common sense. In talking of the matter I would use the word "capacity" instead of "efficiency." The full stroke of the piston of the low pressure cylinder is followed by an inrush of air behind it which fills the entire space, and then the inlet valves close. If upon the return stroke all of this air could be expelled into the passage leading to the intercooler and then the discharge valves closed, that volume multiplied by the number of strokes per minute would be the capacity of the compressor for the same unit of time.

We all know that some of this air is not expelled or delivered, being retained in the unavoidable clearance spaces and re-expanding upon the return stroke of the piston; also there usually are more or less piston leakages and valve leakages, so that the actual volume of air delivered is a more or less uncertain quantity, but whatever this quantity may be which passes the discharge valves and so on through the intercooler must, barring leakages, go on through the machine and be delivered into the compressed air system. An intercooler—even Mr. MacCamy's—does not create air and does not destroy air, and, as was said above, cannot have a retroactive effect upon anything that goes on in the low pressure cylinder. Any assertion of results contrary to this is absurd.

The normal function of the intercooler is to reduce the temperature of the partially compressed air delivered by the low pressure cylinder, and consequently its volume, so that the power required for the second stage of the compression will also be somewhat reduced, but the most valuable effect of the intermediate reduction of temperature is the prevention of excessively high temperature at the completion of the final compression. As Mr. MacCamy concedes that the old intercooler in his narrative could be made to cool the air with tolerable respectability, it is not worth while to go into that matter here. Air apparatus has been improved rapidly, and the intercoolers of all the builders may be expected to be more efficient than was that one of an earlier date.

The function of the intercooler in reducing the tempertaure of the air affords incidentally an opportunity for removing some—not all by any means—of the moisture carried by the air; and here, as we touch upon what seems to be the hobby of Mr. MacCamy, and what is evidently intended to be the real point of the letter to which I am attempting to reply, too few words will not suffice.

To begin with it is necessary to call attention to some incontrovertible facts. Air always carries water in the form of invisible vapor, and is always picking up water, or, as we say, absorbing moisture, when in contact with water or wet things. This it does up to a certain point when it promptly ceases to take any more, and then it is said to be saturated or to have a humidity of 100 per cent. This saturation point varies constantly with every slight change of pressure or of temperature. As the pressure of the air increases or, what is the same thing, its volume decreases, its capacity for moisture decreases in about the same proportion, but whatever the pressure or relative volume, an increase of temperature increases the water carrying capacity of the air very rapidly. For each rise of temperature of 20 degrees F. the moisture capacity of air is doubled, and of course, it is similarly reduced by similar fall of temperature.

Only one other thing, it is necessary for us to remember as we go along. If the humidity of the air be anywhere below 100 per cent. it will not give up the moisture it carries or will not wet things by contact so that water may accumulate and be drawn off. This we know too well by our personal experiences in the summer time when the humidity may be 80 per cent. or more, and when we suffer great discomfort for which no one has devised a remedy. Immediately, however, that the 100 per cent. limit is passed, say by the cooling of the air, all the water in excess of the 100 per cent. is ready to be given up at once, which gives the mechanical separator its opportunity.

We may suppose an air compressor to be in full operation with the air entering the low pressure cylinder with a humidity of 60 per cent., at a temperature of 60 degrees F. and being compressed and passed on to the intercooler at a pressure of 25 lb. gage. The volume of the air, under adiabatic compression, will be almost exactly one-half, and the relative humidity we might say has thus been raised to about 120 per cent.; but at the same time the temperature of the air has been raised from 60 degrees to considerably above 200 degrees, or the moisture capacity of the air has been doubled seven or eight times, and its per centage of humidity, with all the original moisture still in the air, becomes less than 10 per cent., very dry air indeed, as it enters the intercooler.

It is all very well for the intercooler to be posing before the public as a highly efficient water separator, and I am not refusing to believe what it may actually be doing in that line, nor am I by any means belittling the desirability of getting as much water as possible out of the air at this stage; but I would like to call attention to the lively work which the intercooler has to do. It will appear that the whole intercooler cannot by any means be made to act as a water separator, but only a little of the latter portion of it, because the air has to be cooled from above 200 degrees to below 100 degrees before it will begin to give up its water at all.

We thus see the importance, if any water separating is to be done at this stage, of having the intercooling as efficient as possible, since it is only the last few degrees of the cooling that bring the air to the supersaturation point. A much better arrangement in any case would seem to be to have an intercooler doing only the intercooling and then to pass the air through an efficient separator as a distinct unit and taking all the air necessarily at its lowest temperature.

The air after passing the best possible intercooler and separator and then being compressed to its final pressure in the high pressure cylinder will be discharged from the latter, the same as from the low pressure cylinder, in the condition of extremely dry air, on account of its high temperature, but with an aftercooler and another separator, or with a pipe line of sufficient length to give the air a chance to get entirely cool again, the water will again be in evidence. It is only when the air is at its highest pressure and its lowest temperature that it can be so drained of water as to cause no possible subsequent trouble, and neither of these conditions occur in any intercooler.

I regret very much that I have felt compelled to use so many words in the case. I hope that Mr. MacCamy will next time give me complete and precise data to work on.

Frank Richards.

NEW BOOK

How to Run an Automobile. By Victor W. Page. Norman W. Henley Publishing Co., New York. 178 pages, 5 by 7½ in. 72 illustrations. Price $1.00.

This book is by an engineering writer of large experience who has made the automobile his special study. It deals with all the well known automobiles in general and in detail, giving explicit instructions for starting and running. All the problems are given their solution both for regular running and for the derangements and accidents which are sure to occur. There are four chapters as follows: Automobile parts and their functions, General starting and driving instructions, Typical 1917 control system, Care of automobiles. The illustrations are exceptionally intelligible and greatly assist the text, which also is clear and simple.

NOTES

In the seventeen years from 1898 to 1915 the consumption of artificial gas from by-product coke ovens and from coal, oil and water gas plants increased more than fivefold. Very significant is the increasing use of artificial use for illumination. The by-product coke gas for fuel, and, since 1908, its decreasing use for illumination. The by-product coke oven saves the gas; the old beehive coke oven wastes it on the atmosphere.—*United States Geological Survey.*

A graphic chart published by Lord & Thomas, Chicago, shows the resources of the United States are:

World's Area	7%
World's Population	6%
World's Corn	75%
World's Cotton	66%
World's Petroleum	66%
World's Copper	50%
World's Iron	40%
World's Coal	40%
World's Manufactures	30%
World's Wheat	25%
World's Railways	40%
World's Banking Power	35%
World's Wealth	30%

To stop leakage through concrete, such as tunnel walls, clean the walls thoroughly, and paint with a solution consisting of 8¾ lb. of zinc sulphate dissolved in a gallon of water. The zinc sulphate will act on the lime in the cement, forming insoluble calcium sulphate and zinc hydroxide, which fills up the pores in the concrete. Another method is to use one part water glass (sodium silicate) to five parts of water and apply a coat with a brush. Let it dry about six hours and apply another coat. Repeat until four coats have been applied, not allowing over 20 hr. between coats.

George A. Burrell, formerly in charge of natural gasoline resources, Bureau of Mines, asserts that 40,000,000,000 cubic feet of gas will be treated for gasoline extraction in 1917 as against 24,000,000,000 cubic feet in 1916. Mr. Burrell states that the gas, before the extraction, usually burns incompletely and leaves soot in the ordinary gas burner or stove. Removing the gasoline remedies this condition and the heavier soot-forming ingredients are converted into gasoline. The larger part of this gas will finally be used in towns and cities and will represent gas, that if it were not for the gasoline extraction, would never reach the consumer.

Most modern magnets for magneto ignition apparatus contain from 5 to 6 per cent. of tungsten, and from 0.5 to 0.7 per cent. of carbon. The heat treatment of magnet steel is totally different from that of high-speed steel. The temperatures must not be so high, or the permanence will be affected.

An interesting feature of the emergency hospital of the American Steel & Wire Company, at Fairfield, Ala., is that the office of the safety inspector adjoins that of the surgeon in charge. When an accident case is brought in, the safety inspector makes an investigation of the cause of the injury at the same time the surgeon is preparing to take care of it.

Suitable solders for any purpose can be made by judicious mixing of several constituents with lead and tin. For use in working at low temperatures, a low m.p. solder can be made by adding bismuth. A mixture of two parts of bismuth and one each of lead and tin melts at about 93 deg. Cent. (200 F.), while by the addition of mercury or alkaline metals, solders fluid at ordinary temperatures can be made. On the other hand, joints to withstand high temperatures can be made with brass, which requires the use of the blowpipe—hard soldering. In selecting a solder with respect to the temperature which the united metals can withstand, it should be borne in mind that the closer the melting points of solder and metals are together the better will be the joint.

Six clothing disinfectors of a new portab! type have been purchased for the use of the U. S. army, says the *Army and Navy Journal.* The contrivance is the invention of a New York doctor. Each disinfector is capable of handling fifty uniforms and kits in forty minutes, or more than the equivalent equipment of two regiments in a day. The outfit includes a five horsepower upright steam boiler connected by piping with an air-tight chamber 6 ft. long and about 34 in. wide. The rear end of the chamber is provided with a heavy door which can be hermetically sealed. A rack for clothing slides into the chamber, while smaller articles are laid on a grating. The process includes the use of either dry steam or formaldehyde and ammonia. The mobility of the outfit is its distinguishing feature.

Cork fabric is a recent French production, the result of a new process. It is waterproof, a non-conductor of heat, and unbreakable. By using a special machine, thin slices of cork of an even thickness are obtained from a block of cork. The slices are placed in chemical baths in order to remove the resinous parts, which make cork more or less brittle substance. Upon their removal the cork sheets become flexible, and may be compared in this respect with thin leather. In fact, the sheets can be folded and bent without breaking. By combining the cork sheets with any suitable cloth, preferably a thin and strong cloth of good colour, an excellent waterproof material is obtained. An adhesive preparation is employed to glue the cork to the cloth; or if a stronger garment is desired, the cork sheets are placed between two layers of cloth.

Trinitrotoluol and picric acid explosives can be manufactured at a cost about 40% less than nitroglycerine. From this circumstance J. R. Mardick, writing in *Metallurgical and Chemical Engineering,* points out the probability that the manufacturers of these nitro-aromatic explosives will dominate the market for blasting compounds after the war. This would cheapen mining operations. The enormous increase in by-product coking since 1914 renders this assumption highly probable. since the raw materials for 'T.N.T.' and picric acid are derived from that process.

Hard clay in the heading of a 6 1-2-ft. sewer tunnel in Milwaukee was excavated by a chisel shaped cutter operated in a pneumatic hammer and pushed against the vertical face so as to remove long strips of clay, much as cut steel can be curled off the edge of a plate by an expert chipping machinist. By this method the efficiency of the workmen was increased about 140 per cent. over that when the excavation was made with pick and mattock.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

APRIL 3

1,221,022. METHOD OF EVAPORATING AQUEOUS SOLUTIONS. Raymond U. Bunkre, Yonkers, N. Y.

1,221,069-70. LIQUID-ELEVATING APPARATUS. Felix J. McGuane, Chicago, Ill.

1. In a device of the class described, a fluid-pressure-actuated liquid-ejecting means, embodying a liquid outlet conduit and a fluid pressure inlet conduit; a pressure storage tank in communication with the outlet conduit; an expansible element responsive to a diminution of pressure in the tank; a valve in the inlet conduit; an operative connection between the expansible element and the valve for opening the valve; and a cut-off device in the outlet conduit, the cut-off device being manipulable to permit the passage of liquid through the outlet conduit and to effect a diminution of pressure in the tank.

1,221,079. AIR-BRAKE FOR LOCOMOTIVE-CRANES. Benjamin Mullin, Jersey City, N. J.

1,221,080. PNEUMATIC CONVEYER. John D. Murray, San Francisco, Cal.

1,221,103. VACUUM SUCTION DEVICE. John Sorensen, Brooklyn, N. Y.

1,221,104. PROCESS FOR MAKING COATINGS OF FUSIBLE SUBSTANCES. Georg Stolle, Berlin-Schoneberg, Germany.

1. The process for coating an object with a fusible coating, which comprises volatizing a coating material and projecting said volatilized coating material against the surface of the object by means of a compressed inert gas.

1,221,110. GRAIN-SEPARATOR. Charles Argyle Torrence, Regina, Saskatchewan, Canada.

1,221,129. DRYING APPARATUS. Charles H. Benedict, Chicago, Ill.

1,221,131. AIR-COMPRESSOR. William F. Blanchet, Tampa, Fla.

1,221,162. PNEUMATICALLY - OPERATED MUSICAL INSTRUMENT. John P. Eustis, Newton, and Albert T. Brown, Arlington, Mass.

1,221,170. PRESSURE-FOUNTAIN PAINT-BRUSH. Stanley Gasparaitis, Chicago, Ill.

1,221,240. AIR-LINE-PIPE CONNECTION. Lewis Steidle, Mauch Chunk, Pa.

1,221,246. RESPIRATOR. Carl Travers, Frankenholz, near Mittelbexbach, Germany.

1,221,295. AUTOMATIC AIR-PUMP. George W. Dopkins, Morris, Minn.

1,121,321. MEANS FOR BLOWING ICE-CREAM FROM MOLDS. Lionel Manuel Hender, Baltimore, Md.

1,221,328. AIR HEATER AND DRIER. Henry B. Hudepohl, Mount Healthy, Ohio.

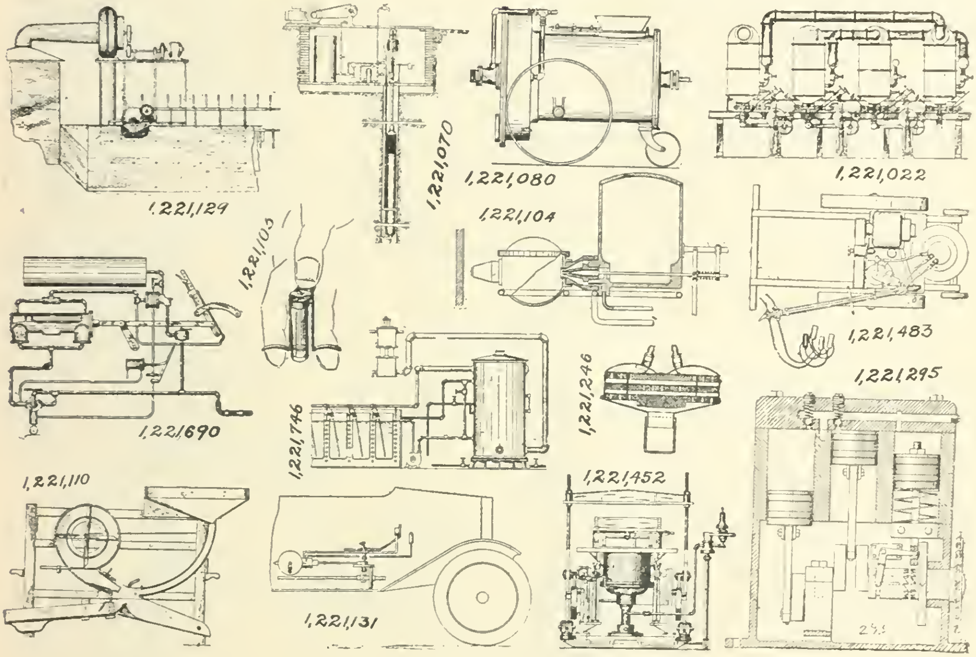
1,221,452. MOLDING-MACHINE. John Louis Johnson, Chicago, Ill.

1,221,483. MILKING-MACHINE. David Townsend Sharples and Lawrence P. Sharples, West Chester, Pa.

1,221,495. PNEUMATIC HAND CONTROL FOR TALKING-MACHINES. Clinton E. Woods, Bridgeport, Conn.

1,221,496. LEAK-OBTURATING DEVICE FOR SHIPS. Frederic Wullyamoz and Gustave Meyer, Lausanne, Switzerland.

1. A leak stopper having a pneumatic frame, an obturating curtain carried by said frame and adapted to be placed against a surface to be repaired, and braces for said curtain and frame.



Pneumatic Patents April 3.

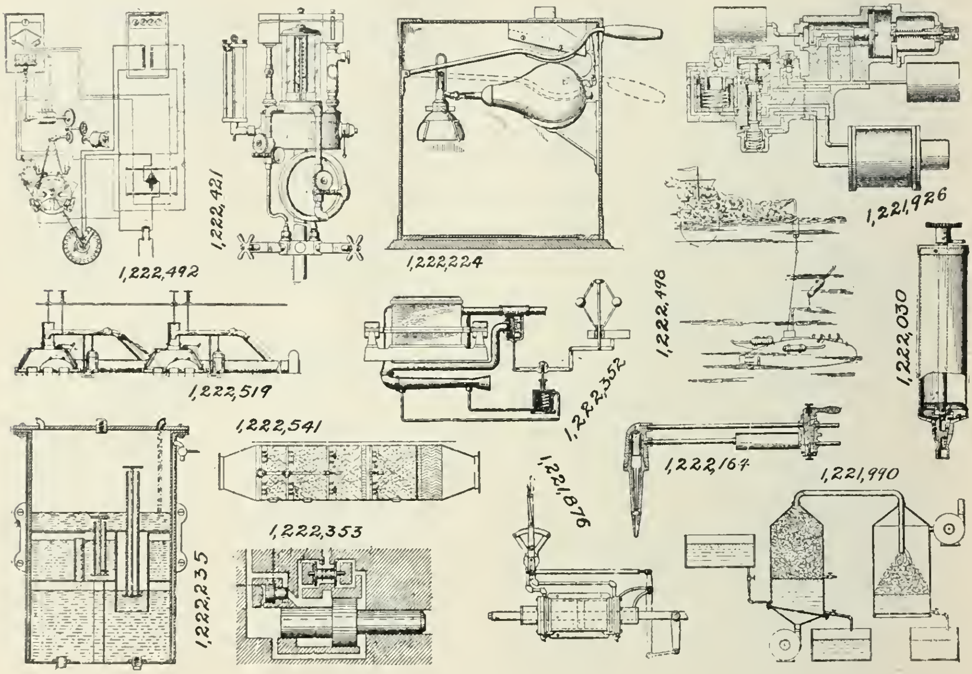
1,221,637. AIR SYSTEM FOR FORCING LIQUIDS. Charles A. Waitz, Bouseville, Pa.

1,221,676. PNEUMATICALLY - OPERATED CAM-CONTROLLER. Frank E. Case, Schenectady, N. Y.

1,221,690. SAFETY DEVICE FOR RAILWAYS. John S. Crawford, New London, Conn.

1,221,746. APPARATUS FOR MANUFACTURING ICE. Willis B. Kirkpatrick, Baltimore, Md.

1. In an apparatus for making can ice by the air agitation method, a brine tank, ice cans in the brine, drop pipes near the centers of the cans, air headers leading to the drop pipes, means for supplying air under pressure, means for cooling the brine, a dehydrater consisting of a coil submerged in water and having connections to the brine tank, means for circulating the brine through the coil and passing the air in finely divided particles through the water surrounding the coil, and means for reducing the pressure of the air as it enters the cans.



Pneumatic Patents April 10.

APRIL 10

1,221,826-7. SAFETY DEVICE FOR RAILROADS. Clayton A. Brooks, Girard, Pa.

1,221,876. FLUID - PRESSURE - OPERATED VALVE - GEAR - SHIFTING MECHANISM. Samuel H. Lewis, Richmond, Va.

1,221,924. INDICATING SYSTEM FOR PNEUMATIC CONVEYORS. Albert F. Thompson and Henry T. Free, Kansas City, Mo.

1,221,926. BOOSTER - VALVE FOR AIR-BRAKES. Walter V. Turner, Edgewood, Pa.

1,221,990. PROCESS OF OBTAINING STARCH. Hiram C. Holden, Pittsburgh, Pa.

3. The process of separating impurities such as gluten and fibrous material from starch liquor which consists in passing a multiplicity of fine streams of air into the starch liquor under pressure, thereby causing a voluminous froth and entangling said impurities therein, applying suction to the froth to remove the same from the starch liquor, and collecting said froth in a receptacle apart from the starch liquor.

1,222,030. AIR-PUMP FOR GASOLINE-TANKS. George E. Raymond, Los Angeles, Cal.

1,222,084. BURNER. Charles Donaldson, Brookville, Pa.

1,222,164. CONTROLLING - VALVE FOR ACETYLENE CUTTING AND WELDING TORCHES. Walter W. von Todenwarth, Rahway, N. J.

1,222,224. PERFUME-VENDING MACHINE. John F. McNeil, Phoenix, Ariz.

1,222,235. FUEL - FEEDING DEVICE FOR AUTOMOBILES. William H. Muzzy, Detroit, Mich.

1,222,321. VALVE FOR COMPRESSORS AND PUMPS. Arthur E. Peters, Easton, Pa.

1,222,352. REGULATING MECHANISM FOR CENTRIFUGAL COMPRESSORS AND PUMPS. Otto Banner, Easton, Pa.

1,222,353. VALVE FOR PERCUSSIVE TOOLS. Lewis C. Bayles, Easton, Pa.

1,222,410. COMPRESSED-AIR SHUTTLE-OPERATING MECHANISM FOR LOOMS. Harry H. Kelley, Atlanta, Ga.

1,222,421. APPARATUS FOR ADMINISTERING ANESTHETICS. David Lambert, New York, N. Y.

1,222,454. PNEUMATIC CARPET-CLEANER. Edwin E. Overholt, Washington, D. C.

1,222,477. VACUUM-CLEANER. John W. Shanahan and Francis C. Mason, Grand Rapids, Mich.

1,222,492. FLUID-METER. Carl Clapp Thomas, Madison, Wis.

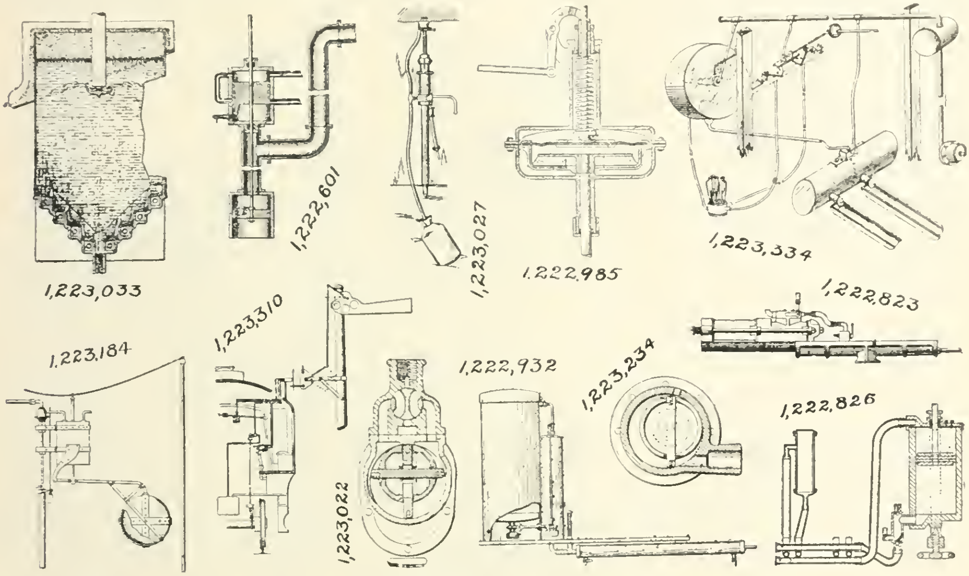
1,222,498. SUBMARINE WARFARE. Joseph A. Steinmetz, Philadelphia, Pa.

2. The combination with a submarine, of a gas tank secured upon the exterior of the submarine and adapted to hold a large supply of incapacitating gas, and means controlled by those within the submarine for allowing said gas to pass rapidly into the free air above the submerged submarine.

1,222,519. AIR-CONTROL SYSTEM FOR FURNACES. William H. Bradley, Pittsburgh, Pa.

1,222,520. PNEUMATIC - TIRE INFLATER. Matt Buzzard, Fenton, Mich.

An acetylene gas generator comprising a pair of vessels, a partition between said vessels, gas discharge means for one of the vessels, a tube extending through the other vessel and the partition and detachable from the latter to permit the flow of water from said vessel to the other



Pneumatic Patents April 17.

1,222,541. COMPRESSED-AIR WASHER. Benjamin C. Donham, Glen Ridge, N. J.

1. An air washer comprising a conduit for the air, and means to pass liquid in different conditions of fineness of sub-division into said air, and including means to effect atomization of the liquid, but retaining it in a condition of free moisture, whereby foreign particles may be precipitated by such free moisture.

1,222,554. VENTILATOR. Herman H. Lind, Lakewood, Ohio.

1,222,569. VENTILATING SYSTEM FOR TUNNELS AND THE LIKE. Denton K. Swartwout, Cleveland, Ohio.

1. In a ventilating system for tunnels, the combination of a movable partition that is adapted to separate the tunnel into two compartments, and a forced-draft apparatus arranged to suck air out of one of the compartments and exhaust it into the other.

APRIL 17

1,222,601. APPARATUS FOR PUMPING FLUID. Osmon B. Campbell, Jr., St. Joseph, Mo.

1. In a liquid pumping apparatus, a liquid conduit having a valved inlet near its lower end, a liquid pump, and an engine of the internal combustion, two-cycle type, in such operative relation that an explosion occurring in the combustion chamber of the engine will impart upward motion and impetus to liquid in the conduit, and that gases passed to the combustion chamber of the engine will be compressed therein by the descent of liquid through the liquid conduit into the liquid pump.

1,222,758. VALVE FOR PIPES FOR THE CONDUCTION OF LIQUID AND GASEOUS FLUIDS. George C. Hall and Alfred Bradshaw, Calgary, Alberta, Canada.

1,222,823. PNEUMATIC DRILL. James C. H. Vaught, New York, N. Y.

1,222,826. MILKING-MACHINE APPARATUS. John Wilfred Llewellyn Warren, Auckland, New Zealand.

1,222,932. STERILIZING APPARATUS. Leon Chevalle, Sardis, British Columbia, Canada.

1. In a sterilizing apparatus of the class described, the combination with a container provided with an outlet faucet in its lower portion and an inlet passageway in its upper portion, of a tank containing compressed sterilized air; a valve-controlled pipe connecting the interior of said tank with said inlet passageway; and mechanism operatively disposed to connect the valve-cock of the valve of said valve-controlled pipe with the valve-cock of said faucet and adapted to be manually operated first to admit said sterilized air into said container and thereafter to open the passageway through said faucet.

1,222,984-5. PRESSURE-OPERATED APPARATUS. Gordon C. Pharo, Marysville, Cal.

1,223,022. PNEUMATIC DRILL. Archie M. Baird, Topeka, Kans.

1,223,027. DUST-COLLECTOR FOR ROCK-DRILLS. George C. Brackett, Denver, Colo.

1,223,033. APPARATUS FOR SEPARATING OR CONCENTRATING ORES. David Cole, Morenci, Ariz.

1. In a frothing classifier, a tank, and a porous medium through which air is admitted to said tank, said porous medium being ar-

ranged with different portions thereof at different levels and being of different thicknesses at the several levels respectively.

1,223,048. PNEUMATICALLY-PLAYED MUSICAL INSTRUMENT. Gustav Karl Hennig, Bohlitz-Ehrenberg, near Leipzig, Germany.

1,223,184. WAVE-MOTOR. August Victor Larson, Bridgeport, Conn.

1. A wave motor including a standard, a post adjustably mounted therein, a compressor cylinder carried by said post, a float, an arm carried by said float pivotally supported by said cylinder, and means for locking said post in adjusted position.

1,223,234. PNEUMATIC TEST-HOLE DRILL. Archie M. Baird, Topeka, Kans.

1,223,265. PNEUMATIC ACTION FOR PLAYER-PIANOS. Judson Rogers De Noyelles, Binghamton, N. Y.

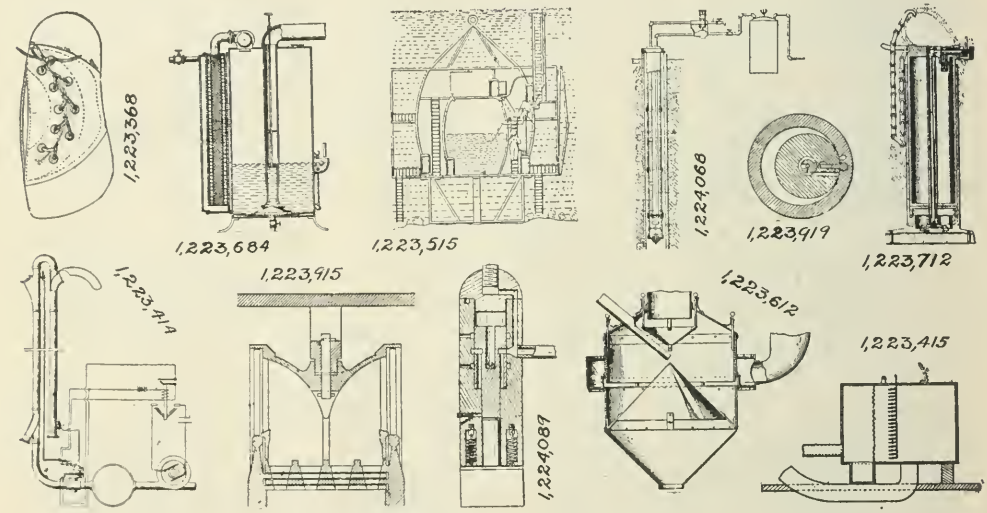
1,223,310. AUTOMATIC TRAIN-STOP. Ephraim Chabot, Providence, R. I.

particles of material collected therein, and means permitting vertical adjustment of said deflector plate.

1,223,682. PUMP OR COMPRESSOR FOR MOTOR-VEHICLES AND THE LIKE. Alfred H. Fefelle, Buffalo, N. Y.

1,223,684. VENTILATION AND CLEANING DEVICE. John C. Fleming, Boston, Mass.

2. An improved method of ventilation and cleaning air comprising guiding a stream of atmospheric air at atmospheric pressure to the bottom of a purifying liquid, maintaining a rarefaction of air above the surface of said liquid, thereby causing said air at atmospheric pressure to pass downwardly into the liquid and then to be discharged upwardly therefrom by its natural force, whereby the air is rarefied and cooled, neutralizing any impure gases intermingled with the air, and finally delivering the purified air to the space to be ventilated.



Pneumatic Patents April 24.

1,223,334. MILKING-MACHINE. Johan Wielaert, Remuera, Auckland, New Zealand.

APRIL 24

1,223,368. PNEUMATIC ARCH - SUPPORT. Rose Schuessler Carling, Los Angeles, Cal.

1,223,407. RIVETING-TOOL. Walter Leon Lindsay, Chicago, Ill.

1,223,414. PNEUMATIC - DESPATCH - TUBE APPARATUS. John T. Needham, New York, N. Y.

1,223,415. BOLL - WEEVIL - DESTROYING MACHINE. James H. Nolin, New Brockton, Ala.

1,223,515. DIVING APPARATUS. Athanasios Papanastasiou, East Pittsbrugh, Pa.

1,223,586. CEMENT-GUN APPARATUS. John F. Johnson, Pittsburgh, Pa.

1,223,612. SEPARATOR FOR GRINDING-MILLS. William J. Price, Dixon, Ill.

5. A separator for use in connection with grinding mills, said separator comprising a casing having pneumatic separating means therein, the lower end of said casing having a coarse material outlet while a fine material discharge pipe extends from the upper end of said casing, a funnel-shaped deflector plate disposed beneath and of greater diameter than said pipe, said plate having a central opening to discharge comparatively large

1,223,712. FLUID-PRESSURE LIFTING-JACK. John Max Meyers, West Chester, Pa.

1,223,758. PNEUMATIC MOTOR. George P. Brand, New York, N. Y.

1,223,885. AUTOMATIC REGULATOR FOR PNEUMATIC PIANOS. Vern L. Jones, Detroit, Mich.

1,223,915. ELASTIC-FLUID TURBINE. Oscar Anton Wiberg, Finspong, Sweden.

1,223,919. ROTARY PUMP. Walter J. Wilson, Petersburg, Ind.

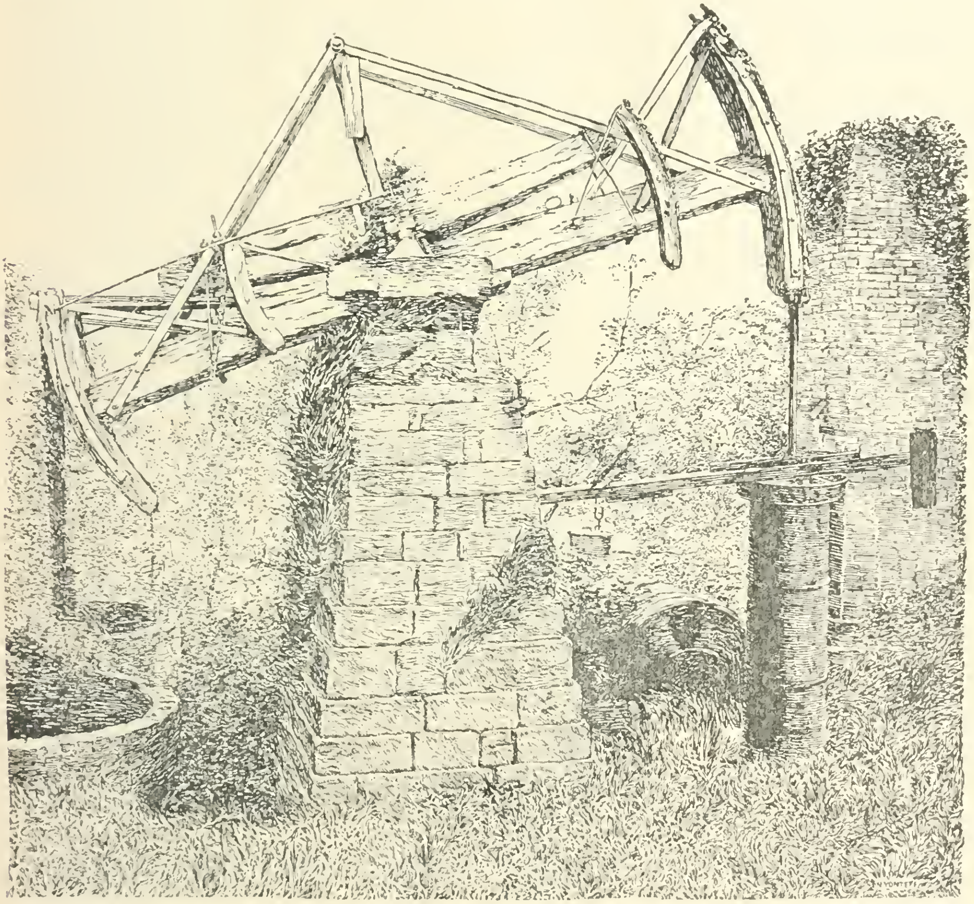
1,224,068. PNEUMATIC WATER-LIFT. John G. Chason, Colquitt, Ga.

2. In a device of the class described, a water outlet pipe, an air inlet pipe, a cylinder connected to the outlet pipe, a piston operable in said cylinder, a pistod rod extending upwardly from said piston, a cross head carried by the piston rod, arms extending downwardly from said rod, a weight supported by the lower ends of the arms, a normally closed valve in the inlet pipe, and a stem positioned above said valve and beneath the weight for engagement with said valve when the weight descends, the said piston lowering under the influence of the weight when the pressure in the cylinder becomes reduced.

1,224,089. PNEUMATIC SCALING-TOOL. Elmer A. Hawley, Des Moines, Iowa.

COMPRESSED AIR MAGAZINE
EVERYTHING PNEUMATIC

Vol. xxii. JULY, 1917 No. 7.



JAMES WATT'S OPPORTUNITY

AN ORIGINAL ATMOSPHERIC ENGINE

The cut above is from a photo supplied by Maurice Lees, Park Bridge, Ashton-under-Lyne, and recently published in The Engineer, London. It shows a relic of the early days of steam engineering still in existence as shown at Fairbottom, although it has been out of service nearly a hundred years. It is a Newcomen pumping engine, many of which found employment at the English coal mines.

In the view the steam cylinder is at the left and the pump at the right. It of course is not the pump cylinder which is seen, as that is down in the mine and the pump works by direct lift. The steam cylinder is 26 or 28 in. diameter with a stroke of about 6 ft. The beam is of wood braced with iron and has segmental ends to which the steam piston and pump rods are attached by chains.

There was normally a slight preponderance of weight on the pump end of the beam, so that when steam at atmospheric pressure was admitted under the piston it would rise and the pump bucket would descend. When the piston reached the top the steam was shut off, the valves being originally manipulated by hand, and a jet of water was discharged into the cylinder condensing the steam and forming a vacuum, more or less complete, when the piston was forced down by atmospheric pressure thus lifting the water. The operation was necessarily slow and the waste of fuel enormous especially on account of reheating the cylinder after each strike.

Here, as was easily seen after the event, was the unique opportunity for the genius of Watt, whose first invention and probably his greatest, in connection with the steam engine, was the separate condenser. From this beginning the complete automatic engine was rapidly developed with results which have revolutionized the world more completely than all the wars.

A BELT RECORD WORTH PRESERVING

Among the exhibits at the Centennial Exposition of 1876 was a 60-in. double leather belt, 187 ft. long, shown by J. B. Hoyt & Co., of New York. This was the widest and largest leather belt that had ever been made, and was intended for the Augustine mills of the Jessup & Moore Paper Co., of Wilmington, Del., to whom it was delivered early in 1877.

This belt transmitted 650 to 700 hp., traveling over 24-ft. diameter pulley on the engine to a 9½-ft. pulley on the line-shaft, at an engine speed of 52 r.p.m., or a belt speed of 3920 ft. per minute, or 44.5 miles per hour. This mill operated continuously, starting at midnight Sunday and continuing in operation until midnight the following Saturday, so that the belt ran 24 hours per day, and averaged 300 days per year.

In 1902 the old belt had run 25 years, and in that time had traveled 8,010,000 miles, but its usefulness was by no means over. It always ran under damp conditions, because of its proximity to water, but notwithstanding these unfavorable conditions, when in 1902 it was sent to the factory to be cut into a 36-in. and other sizes, it was not rebuilt and there were no material repairs made upon it, and the same cement that was applied in 1876 is today holding the 36-in. belt together, and it has satisfactorily transmitted 350 h.p., equivalent to a working load of 198 lb. per sq. in. of sectional area plus tension, from 1902. It is still running 144 hours per week, with prospect of several years more of usefulness in its present position. When the time comes to replace it, it will be possible to cut it up into smaller belts, which will probably be used successfully for many years in places where the performance is less exacting in its requirements, and these again, when their days of usefulness in the particular duty assigned them is over, may be cut into still smaller belts, and so on, and the final remains will have a value for heels and washers.

The longevity of this belt is not due to the lightness of its load, for its maximum transmission of 700 hp. is equivalent to a working stress of 262 lb. per sq.in., plus its tension—no small load; nor has it been due to superior care.

This belt, now operating over a 16-ft. engine pulley at 82 r.p.m. to a 6-ft. pulley on the mainshaft, has a belt speed of 4122 r.p.m., equivalent to 46.8 miles per hour, and in its present position in 15 years it has traveled 5,256,576 miles, which added to the distance which it traveled as a part of the 60-in. belt, equals a total of more than 13,266,576 miles with a considerable addition to be made to these figures by its subsequent performance.

This belt, 187 ft. long, probably cost originally about $1250. There has been expended upon it practically nothing for repairs, and the cost of transmitting 650 to 700 hp. for 25 years, and 350 hp. for 15 years, to say nothing of the transmission by the smaller belts cut from the original belt, has cost $75 per annum for interest, and the amortization of the original cost will be completed at an annual cost of about $31, a total cost of about $106 per annum; or disregarding the service rendered by the smaller belts, and averaging the loads with the years of service of the 60- and 36-in. belts at 570 hp., this power has been transmitted at a cost of about 18c. per horsepower per annum.

WHAT THE INTERCOOLER CAN DO

BY FRANK RICHARDS

"I am in a kind of a mix-up about intercoolers upon two-stage air compressors, what they are for—although in a general way I suppose I know that—what they will do and what they will not do in the reduction of the intermediate air temperature, in the reduction of the volume of air entering the high pressure cylinder, and in the saving of power, but more especially I want to know about the extraction of the moisture in the air and the delivery of the air in a more or less dry condition so as to avoid all trouble at the drills or elsewhere from the freezing up, etc. If you will kindly do what you can toward informing me on these points, you will be rendering me a valuable service."

It occurs to me that there are others who are not altogether satisfied upon the points above suggested by my correspondent, so I am laying before the many readers of this publication, without further preface, my reply substantially as communicated to my friend.

FIRST THE SIMPLE AIR PROBLEM

Avoiding theories and formulas as much as possible, we will consider all through the case of an actual compressor, and one with which you happen to be in close touch, the air cylinders, 30 in. and 18 in. in diameter respectively and 27 in. stroke, running at 90 revs. per min., or a trifle over 400 ft. per min. piston speed, and delivering the air at 100 lb. gage. As you are somewhat up in the world and I do not know the altitude we will call it 5,000 ft., the normal atmospheric pressure being 12.14 per sq. in. absolute.

The volume of free air taken into the low pressure cylinder and passed along for delivery will be:

30^2 x .7854 x 400 ÷ 144 = 1964 cu. ft. per min. This is the full theoretical capacity of the cylinder, and a certain allowance must be made for the unavoidable clearance and piston leakage, also for the losses due to the leakage and unprecision of action of inlet and discharge valves. If we deduct 10 per cent. we then have

1964 — 197 = 1767 cu. ft. per min.

which may be said to be better than the average performance of up-to-date compressors. But, whatever the clearance and leakage losses may be, the actual volume of air which passes the discharge valves of the low pressure cylinder, and is retained by them, must then go through the machine and be delivered into the compressed air system, subject of course to any other leakages that may occur. It seems absurd to have to say that the quantity of air thus passing the discharge valves cannot be increased or diminished by the presence of the intercooler. If it has ever been said that the volume of air delivered has been apparently increased through any changes in the intercooler it must be attributed to a general overhauling or tightening up of the machine when the change was made or to an increase of the speed of the compressor.

To ascertain the power saved by two-stage compression with efficient intercooling, we will first find what the power cost would be by single stage compression. We assume, then, that the entire work of compression is done adiabatically in the low pressure cylinder. With the free air intake pressure of 12.14 lb. abs. and the delivery pressure 100 lb. gage, the ratio of initial and terminal pressures will be 12.14 ÷ (100 + 12.14) = 1082. With this ratio of pressures the ratio of volumes (Richards' Compressed Air Practice) will be .206.

Incidentally we may note the temperatures. With the above ascertained ratio of volumes the ratio of temperatures will be .5246. If the initial temperature of the air is, say, 70 deg. F. the terminal temperature will be (70 + 461) = 531 ÷ 5246 = 1012 deg. abs. or 1012 — 461 = 551 deg. F. No matter how efficiently the cylinder and cylinder heads were water jacketed the discharge temperature of the air would not be below 500 deg. F. which alone gives us sufficient reason for avoiding single stage compression for such high delivery pressures.

Now as to the power required. The ratio of volumes being .206 the ratio of the terminal and the mean pressure will be .4458 and the absolute mean pressure will be 112.14 x .4458 = 49.99 and 49.99 — 12.14 = 37.85 the actual working mean effective pressure. Then the power required will be 30^2 x .7854 x 37.85 x 400 ÷ 33000 = 324.3 H. P.

We are now ready to compare this result with that of two stage compression. With a reasonably efficient intercooler we may suppose for convenience that the intake temperature is the same, say 70 deg. F., for both the low pressure and the high pressure cylinders, which might occur at certain seasons. It would be only necessary to have the cooling water at 50 deg. to secure this condition for the high pressure intake, and more than one builder of air compressors would be ready to guarantee this.

The diameters of the cylinders being respectively 30 in. and 18 in. the ratio of volumes will be $18^2 \div 30^2 = .36$, and as the intake air temperature is the same in both cylinders, the same ratio, inversely, will apply also to the pressures, and the intake pressure of the high pressure cylinder therefore will be $12.14 \div .36 = 33.72$ abs., or $33.72 - 12.14 = 21.58$ gage.

Here we encounter a curious condition and it must not be lost sight of in our computation. On account of the cooling effect of the intercooler, the volume of compressed air delivered by the low pressure cylinder is considerably larger than the volume of air, though at practically the same pressure, taken in stroke by stroke, by the high pressure cylinder, and it is upon the basis of this larger volume compressed and delivered that the power consumption of the low pressure cylinder must be computed.

The ratio of pressures being .36 the ratio of volume before and after adiabatic compression in the low pressure cylinder will be .484, and the ratio of mean pressure per stroke to terminal pressure will be .788. The mean pressure per stroke, then, will be $33.72 \times .788 = 26.57$ abs. or $26.57 - 12.14 = 14.43$.

For the power required for the low pressure cylinder we now have:

$30 \times .7854 \times 14.43 \times 400 \div 33000 = 123.64$

The intake pressure of the high pressure cylinder being 33.72 abs. and the delivery pressure 112.14 the ratio of pressures will be $33.72 \div 112.14 = .30$. Then the ratio of volumes (Richards' Compressed Air Practice) will be .425 and the ratio of mean to terminal pressure .7319. Then the mean effective pressure for stroke will be $112.14 \times .7319 = 82.08 - 33.72 = 48.36$.

The power required for the high pressure cylinder, therefore, will be $18^2 \times .7854 \times 48.36 \times 400 \div 33000 = 149.16$ h. p. and the total horse power for both cylinders $123.64 + 149.16 = 272.8$ h. p. which is 84 per cent. of the power we found to be required for single stage compression.

The computation above would have been much more complicated if all particulars and allowances had been included, and the actually possible saving of power, even theoretically, would have been somewhat less than now shown. In practice the actual saving of power may be said to seldom exceed 12 per cent. instead of the 16 per cent. which our computation here shows.

It is not to be too hastily concluded that the saving of power by the use of the intercooler as here shown is scarcely worth what it costs, especially for the temporary installations which compressed air plants so often are; for that is by no means the entire story. It is worth while to consider now the reduction of ultimate temperature effected as having an important bearing on the general problem.

In the low pressure cylinder we found the ratio of initial and terminal absolute pressure to be .36. Then the ratio of absolute temperatures would be .7438. The intake temperature being $70 + 461 = 531$ abs. the discharge temperature for the low pressure cylinder would be $531 \div .7438 = 714$ abs., and $714 - 461 = 253$ F.

The ratio of absolute pressures for the high pressure cylinder being .30 the ratio of temperature is .7055 and the initial temperature $70 + 461 = 531$ abs., being here assumed to be, by the action of the intercooler, the same as that of the low pressure cylinder. Then the terminal or delivery temperature for the high pressure cylinder will be $531 \div .7055 = 752$, and $752 - 461 = 291$ deg. F.

These delivery temperatures of 253 and 291 degs. F. are very different from the 551 deg. which we found to result from single stage compression to the same pressure. The former temperatures would not be sufficient to burn the lubricating oil used and cake or gum up the air valves, but with the latter temperature the case is very different, as many costly experiences have demonstrated. The reduction of temperatures here shown invariably accompanies the employment of any of the efficient intercoolers of the standard compressor builders, and no special intercooler can rightly claim any appreciable efficiency over any other in this respect.

THE WATER IN THE AIR

Another problem in connection with the employment of the intercooler is perhaps still more difficult, and that is its agency in eliminating the moisture in the air. The users of compressed air have been at times annoyed or more seriously inconvenienced by the presence of water in the air delivered, and the unceasing demand is for dry air. Now, there is no such thing as dry free air anywhere, and to call any air dry is only to say it is drier than some other air.

Water is carried by air in two different states or conditions. First—and this is the normal condition—it is mixed intimately with the air in the form of invisible vapor. Water in this form is in the air of the sky even when it is clearest and bluest, and it is also in the air which is taken into an air compressor no matter how dry we may think it. The ability of any body of air to thus carry water vapor is always absolutely and precisely limited, and is determined by its pressure and its temperature. There is always for any body of air a possible point of saturation, a possible combination of pressure and temperature, at which the air will just have all the water vapor it can carry, at which point the humidity of the air is said to be 100 per cent.

At this saturation point, if the pressure of the air is increased, that is if its volume is reduced, or if its temperature is reduced, either or both, the air will at once have more water vapor than it can carry, although the actual quantity of vapor present has not been increased in any way, and the excess of such vapor is immediately condensed or converted into actual water. The air thus, without any change in the actual quantity of water contained in it, at once becomes wet air. The water in excess by this change of air condition is not taken out of the air but remains distributed through it, consisting at first of minute globules which become more or less visible and cause an appearance of fog, mist or cloud.

The operation of changing the surplus of vapor into actual water, although the water is at first in a comminuted state, is essentially an act of condensation, and any intercooler which cools the air sufficiently to accomplish this may call itself a condenser or a condensing intercooler, one as much as another.

The water thus liberated ish eavier than the air in which it is contained and if the air could remain still, without change of pressure or temperature, the water would slowly settle down through it and gather on the bottom of the receiver or other vessel in which it might be contained. Also if the air in this condition were passed through a steam separator or similar device the water would wet and cling to the surfaces with which it might come in contact, slowly trickling down and thus be collected and drawn off. In any separator employed for this service, whether a detail of an intercooler or attached to it, only this water liberated in excess of the saturated quantity can be collected and drawn off.

The vapor carrying capacity of air may be said to be directly as its volume, or inversely as its absolute pressure, if the temperature is not changed. That is, if its volume be reduced one-half by compression, or, which is the same thing, if its absolute pressure be doubled, its vapor carrying capacity will be divided by two. On the other hand if the temperature of the air be increased, without change of volume or pressure, its vapor capacity will be doubled for about each 20 degrees of rise. In the operation of adiabatic air compression—and it is practically adiabatic in each cylinder of a two stage compressor the same as in a single stage machine—it will frequently if not generally occur that the changes in these two conditions of pressure and temperature will operate against and to an extent neutralize each other, because, in the act of compression, reduction of volume is accompanied by increase of temperature.

We are now ready to put the air through our air compressor, running under the conditions previously assumed and thinking now mostly of the water vapor in the air and what becomes of it. We assume that the humidity of the intake free air is 50 per cent. of saturation, or that the volume will have to be reduced one-half, or the absolute pressure doubled, before the 100 per cent. or saturation point is reached. We found in paragraph 12 that the ratio of the volume of air delivered by the low pressure cylinder was to the intake volume as .484:1, so that, as the volume was thus reduced to a little less than one-half, its vapor carrying capacity was a little less than the one-half required for complete saturation and, so far as the volume alone was concerned, there would have been a slight release and condensation of the excess of vapor. This, however, was so slight as to be entirely negligible in view of the rise of temperature which occurred at the same time.

Remembering how rapidly the vapor capacity of air is increased by increase of temperature, it will be easily believed that a rise of temperature of only 5 deg. F. above the initial 70 deg. would have been sufficient to make up for the slight vapor carrying deficiency shown by the terminal volume.

As a matter of fact, we found, paragraph 17, that the delivery temperature of the low pressure cylinder was 253 deg. F., a rise of 183 deg. from the intake temperature of 70 deg. Remembering that the vapor carrying capacity of air is doubled with each rise of about 20 deg., and noticing how many such doublings are here, it is very evident, without going into figuring at all, that the air as compressed in the low pressure cylinder and delivered into the intercooler is exceedingly dry air, notwithstanding that it carries all the vapor that it had when first taken into the cylinder.

The air now enters the intercooler at the temperature of 253 deg. or probably a little less than that, for which the water-jacketing may be thanked, and is there cooled down to the high pressure cylinder intake temperature here assumed to be 70 deg. If the intercooler is disposed to put on airs or to make fine promises as to what it can do as a water extractor it will be well to remember that the air will not give up a drop of water until it is cooled to below the saturation point, and that then it will only give up the excess of water above the saturation point, and no matter how ingeniously contrived and labyrinthian may be the separator devises the air after leaving the intercooler and entering the high pressure cylinder must be at the saturation point, or, as we say, its humidity must be 100 per cent.

Since so small a portion at the latter end of the intercooler is all that can possibly have any effect as a water separator, it would seem to be more reasonable to make the separator a supplementary device through which the air might pass after the cooling of it was entirely completed and just before it entered the high pressure cylinder.

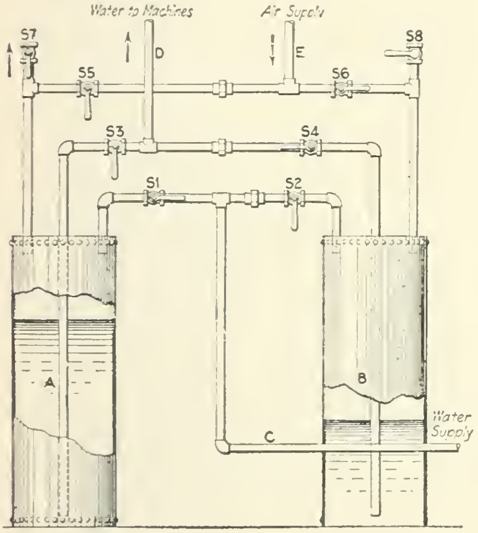
It is worth while to call attention to the amount of water in the form of vapor which is actually carried by the air in the case under consideration. At the assumed temperature of 70 deg. and 50 per cent. saturation the weight of water for 1,000 cu. ft. of atmospheric air is about 0.5 lb. Our compressor we found, paragraph 4, handles, say, 1,760 cu. ft. of free air per min. which, running continuously as compressors are apt to do, would be 2,534,400 cu. ft. per 24 hours, and the water carried through would thus be 1,267 lb., say 158 gallons, or 5 barrels, per day. How many days would it take an intercooler to drain out of this air one barrel of water? As far as my information goes, but this is not at all authoritative, it might take a week to get one barrel of water. This is just a hint of what practically can be done by the intercooler in eliminating the water carried by the air. It suggests how absurd must be the claim that any intercooler can have anything to do with guaranteeing the working dryness of the air after the final compression.

The air entering the high pressure cylinder necessarily at 100 per cent. humidity, or carrying all that it can of water vapor at the existing temperature and pressure, goes through the same experience as in the low pressure cylinder. That is, although in the act of compression its volume is reduced, its temperature is correspondingly increased, so that it is discharged from this cylinder also as very dry air, and only after its final and complete compression to the working pressure can the desired draining of the air be effected.

As the vapor carrying capacity of the air is greatest when its pressure is low and its temperature is high, so its vapor capacity is least when its pressure is high and its temperature is low and then it will readily release its water. These latter conditions naturally occur, or may easily be produced, after the final compression of the air is completed, and then the air may be so completely drained of its water that little or no trouble from that cause will be experienced by the ultimate users of the air.

If the compressed air is to be transmitted only a short distance there should be an efficient aftercooler very near the compressor, with a separator of sufficient capacity for the final drainage of the thoroughly cooled air before any of its pressure is lost. If the air is transmitted at its highest pressure a considerable distance, say half a mile or more, through pipes of liberal capacity, so that the flow will not be too rapid, the air will be well cooled before it reaches its destination, and as it cools it will drop its water to flow along the bottom of the pipes, and if pockets are provided at the low points of the pipe the water will collect there and should be regularly drawn off.

When as the result of either of these arrangements the workers find that they are not troubled by water in the air, if they choose to go back and thank the intercooler for drying the air, when only half compressed, there would seem to be no way to prevent them from doing so.—*Power.*



TO SUPPLY WATER AT SAME PRESSURE AS THE AIR

BY H. H. HODGKINSON*

Water tanks arranged in the manner shown in the accompanying illustration are found to be of great assistance in driving drifts or tunnels where machines are used that require water passed through the drill steel. This method assures the drill runner of a steady supply of water having the same pressure as the compressed air. If the water pressure is greater than the air pressure, the cylinder of the machine soon becomes flooded. This reduces the speed of the drill and also washes all the lubricant out of the cylinder so that the drill finally stops. If the water pressure is lower than the air pressure, the sludge is not cleaned out of the drill hole properly. This not only cuts down the drilling speed, but may result in the loss of a drill steel from becoming stuck in the hole.

Delays in drifting are costly, but by the use of tanks arranged in this manner, it is never necessary for the drill runners to stop their drills for lack of water, it being only necessary to manipulate the four valves or stop-cocks on each tank. The drill runner is assured of good clean water without grit or dirt, which often causes a great deal of trouble, by plugging the water tube of the drill.

As the heading advances, pipe may be inserted between the tanks and the machines instead of moving the tanks each time. It is not necessary to remove the tanks when blasting the heading if they are placed at a safe distance.

The two tanks *A* and *B* are standard stock galvanized iron tanks made by any of the large drill manufacturers and have three holes in the top tapped for standard ¾-in. pipe fittings. Into these holes ¾-in. pipe is inserted, as shown, with the required unions, elbows, tees and eight ¾-in. stop-cocks. Stop-cocks are preferable to valves as they can be opened or closed more readily, show at a glance whether they are open or closed, because of the position of the handle, and are less expensive.

The operation of the tanks is as follows: Assuming tank *B* supplying water to the drills, stop-cocks S_2 and S_8 are closed while S_4 and S_6 are open, allowing water to pass through pipe *D* and air through pipe *E* respectively. In the meantime water is passing through pipe *C* into tank *A* and the stop-cocks S_1 and S_7 are open. S_7 is to allow the air to escape from the tank as the water flows into it through S_1. Stop-cocks S_5 and S_3 are closed. When tank *B* is empty S_6 and S_4 are closed while S_8 and S_2 are opened, which permits the water from *C* to fill it. By closing S_7 and S_1 and opening S_3 and S_5, tank *A* will now supply the water.

Two tanks are necessary; while one is supplying water the other is being filled. It is also necessary to have a supply of water to be piped to the tanks having a head of at least 5 ft., so that the water will flow into the tanks and overcome the friction of the connections.

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*Mining engineer, care of United Verde Extension Mining Co., Jerome, Ariz.

GASES IN TRENCH WARFARE

A bulletin of the American Chemical Society says that the exact composition of the gases used in modern warfare is not known. It would seem that most commonly a mixture of chlorine and bromine is employed; possibly at times with the addition of sulphur fumes or formaldehyde gas. Chlorine and bromine are produced cheaply and in large amounts by the Germans as by-products of other industries. They are among the most active chemical agents known, attacking the eyes and the lining of the mouth, throat and nose. They first produce a hard cough, followed by the spitting of blood and finally asphyxiation, due to the destruction of the breathing apparatus. Only one part of chlorine or bromine in one thousand parts of air is necessary to produce almost instant death; one part in one hundred thousand, if endured for any length of time, is very dangerous.

For use in the trenches the gases are usually liquefied and stored in tanks from which the outflow is regulated by means of a valve. If the ground slopes a little toward the enemy and the wind is in the right direction, the gas, being heavier than air, flows over the ground filling the hollows like so much water. The most successful method for combating the gas attacks is by the use of a gas mask. The modification now employed is a hood, provided with a mica window, that fits down over the head like a bag, buttoning between the vest and shirt. When the first indications of an attack are evident, the hood is moistened with a solution of sodium hyposulphite (the photographer's "hypo") which combines with the gases, rendering them ineffective. Because of the large amount of gas required to poison the constantly changing air, an attack is only of a few minutes' duration. In case one is overcome by the gas, inhalation of dilute ammonia vapors will give great relief, since the ammonia combines with the gas in the bronchial tubes and relieves the difficulty of breathing, although it does not undo the injury already done. Because of the cruel suffering inflicted upon the enemy, the use of poisonous gases in projectiles was forsworn by the signers of the Hague declaration of 1899. The first gas attacks of the Germans took the enemy by surprise and inflicted great loses and an untold amount of suffering. Since then the masks have been so perfected that the troops have lost most of their fear of this ruthless form of battle—thus again emphasizing the fact that this is a war fought by science.

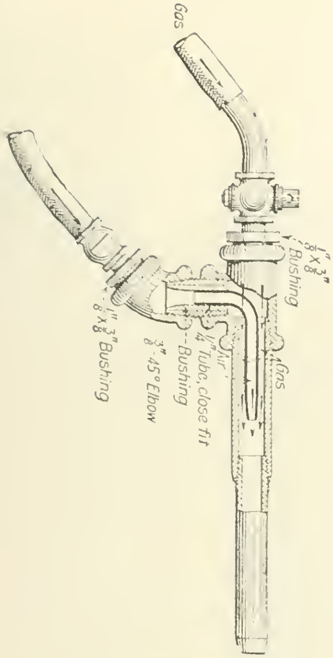
A GULF COAST OIL WORKS COMPRESSOR PLANT

One of the most modern and economical air plants ever installed in a coastal field is being installed for the Humble Oil Company on its Gaillard lease at Goose Creek by the firm of Tennant-Lovegrove Company, Inc., engineers. The plant will cost approximately $50,000 and the first two units will be put into operation on Saturday, May 19. The equipment is on the same basis with the equipment for a big electric light or power plant, economy and efficiency in the long run being considered first.

The boiler equipment consists of two 150-horsepower Franklin water tube boilers. The plant has seven Ingersoll-Rand Imperial type air compressors, each with a maximum compression capacity of 500 pounds per square inch. The total piston displacement for the seven compressors is 3,000 cubic feet per minute. The compressors are equipped with compound steam cylinders, which is an innovation in oil field practice, made necessary by the present high value of fuel oil. A "Booster" compressor, capable of 750 pounds per square inch pressure, is installed to take care of starting conditions or to handle an exceptionally deep well.

A steam pressure of 150 to 160 pounds will be carried. A 600-horsepower Hoppes Feed-Water heater has been installed which will deliver water to the boilers at a temperature of about 210 degrees F. Circulating cooling water for the compressor jackets is supplied from a set of Cameron pumps so interconnected that the plant will never be forced to shut down because of the disability of any one pump to work. A small electric lighting unit has been installed to take care of the power plant and field rig lighting.

The exhaust steam from the air plant will be used for oil cooking purposes, obviating the necessity of operating separate boilers for this purpose, and cutting down that large item of expense.—*Gulf Coast Oil News.*



GAS AND COMPRESSED AIR BLOWPIPE

The illustration shows a blowpipe for soldering, brazing, etc., made from pipe fittings. A copper or brass tube about ¼ in. diameter is filled with melted lead and given a right-angle bend so that it will go into a ⅜-in. tee as shown, after which the lead is melted out. A brass or fiber bushing is then driven into a ⅜-in. short nipple and drilled out to take the bent tube, which should make a close working fit, and the tube is driven into the bushing and the bushing screwed into the tee, the tube turning in the bushing while the nipple is being screwed in. A ⅜-in. nipple about three inches long is then screwed into the end of the tee over the air nozzle, and a ⅛x⅜-in. bushing is screwed into the other end. The air tube should be adjusted centrally in the ⅜x3-in. nipple. Valves or cocks are used to regulate the flow of air and gas.

The apparatus has been found to work best when the air flows through the bent tube as shown and the gas is led through the straight portion of the tee. Any size or shape of nozzle may be used, depending on the character of work to be heated.—*H. H. Parker in Power.*

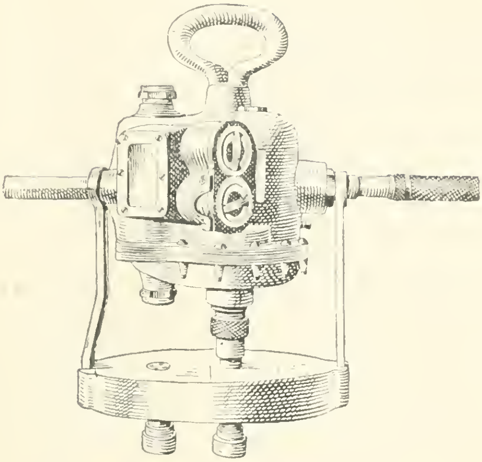


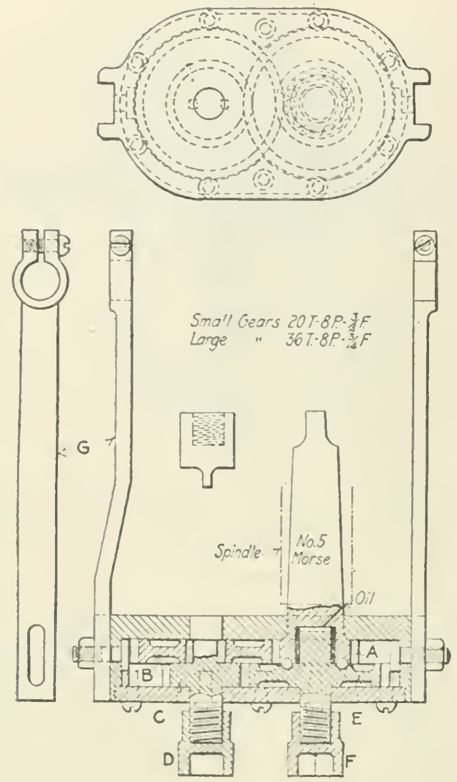
FIG. I

SPEED-REDUCING ATTACHMENT FOR AIR DRILLS

BY HARRY F. PANNEPACKER

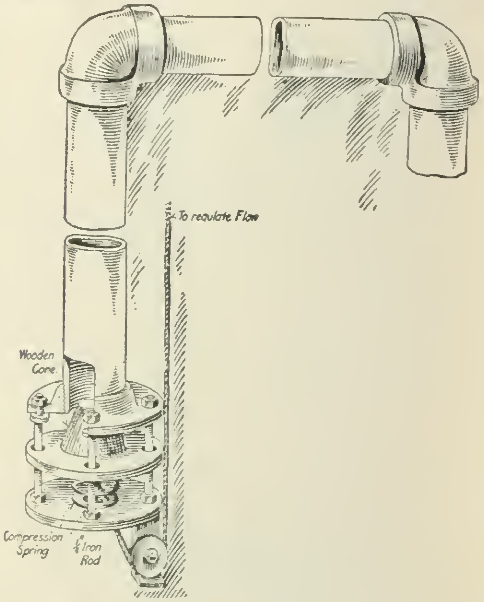
We had to tap over twenty-four hundred 1⅜-in. holes in special treated steel plates made into large structures, the shape of which allowed the use of air machines only. The drilling had been done satisfactorily, but the problem of tapping was still to be solved. The thickness of the plates was 5 in. Some holes were drilled 1$^{7}/_{16}$ in. in diameter half the thickness, the remaining half being drilled 1⅜-in. tap size, while still other holes were simply drilled blind and tapped out 2½ in. deep. Tapping by air machine had heretofore been out of the question, as their speed, 225 r.p.m., equivalent to 81 ft. cutting speed on the diameter of a 1⅜-in. tap, was too high. The air pressure was 78 lb., and several trials proved most unsatisfactory. The speed-reducing attachment shown was then made and connected to the air drill. With it the spindle speed was reduced to 67.5 r.p.m., equaling 24.5 ft. cutting speed, and the results were satisfactory.

Previously, all tapping had been done by hand, a gang consisting of a leader and two helpers, whose capacity was 2½ holes per hour. With the speed reducer, from 15 to 20 holes per hour can be tapped, a distinct advantage being gained in the auxiliary spindle, which extracts the tap at increased speed. The machine is also used to insert the threaded rivets in the holes. As some of these have square



heads of the same size as the taps, this is an easy task. A number of the tap rivets have slotted heads, but a pair of special sockets with tongues drive them very nicely.

The machine, briefly described, consists of a milled flat steel body, 2¾ in. thick by 10¾ in. long, rounded at the ends and containing the four steel reducing gears. A No. 5 Morse shank, turned with the first pinion *A*, Fig. 2, of the train, meshes with the gear *B*. This second gear is keyed to a stud shaft that also carries a pinion *C* and socket *D*, from which is obtained the reversed direction. The gear *E* completes the train and drives the socket *F*. Ball bearings take the thrust. A brass plate screwed into position incloses the gears from the bottom, while extending studs of the two shafts act as receivers for attachment sockets for taps, etc., the main stud running in the right-hand direction and the auxiliary giving opposite direction at increased speed. A flat rod *G*, bolted to each end of the speed reducer and carried up to the handle on each side of the air drill, gives the necessary stiffness. The cost of making was soon covered by the gain in time saved and labor costs.—*American Machinist.*



TO KEEP THE SIPHON CHARGED

CONTROLLING A SIPHON

The objection is sometimes raised to the use of a siphon in draining pits, that it is difficult to regulate the flow so that when the pit is entirely drained the pipe will draw air, necessitating priming it again, and this continual priming might involve more labor than the direct use of a pump. Regulation of the flow of a siphon to any degree up to the capacity of the pipe can be secured by use of a valve made as here described or modified to suit any particular conditions met with in the various uses of a siphon.

The essential parts are shown in the illustration and consist of three flanges fitted to the discharge end of the siphon pipe, four rods, a compression spring, a cone-shaped piece of wood and a piece of rope. One flange is screwed to the end of the siphon pipe and connected to a second flange, by the four rods equally spaced. The cone-shaped piece of wood, which acts as the disk of a valve, seats on the third flange, which is guided by the four rods and forced to its seat by the spring. The rope can be attached to the lower end of the wooden cone and is used to pull the disk away from the mouth of the pipe, thus regulating the flow of water. The spring at all times tends to return the disk to its seat. To make a better job the cone could be covered with rubber packing.

In operation, the longer leg of the siphon is filled with water and the other end placed in the pit that is to be drained. The rope is then pulled, and the water in flowing from the pipe will draw the water from the pit, the amount of water flowing being controlled by the valve opening. To stop the siphon, the rope is released allowing the disk to return to its seat, thus entrapping the water in the long leg, until it is desired to start the siphon again. This means is preferable to the common practice of throttling the intake.—*James M. Purcell in Power.*

SANDSTONE QUARRYING IN THE UNITED STATES

The above is the title of Bulletin 124, recently issued by the Bureau of Mines. Oliver Bowles, the author, also produced last year, "The Technology of Marble Quarrying." Both are admirable pieces of work, and of great value in their respective fields. The topics are thoroughly and concisely treated, the information presented is self evidently reliable and embodies gathered data. The 150 pages, 6 by 9 in., of the present issue are conscientiously filled with valuable matter, with excellent and pertinent illustrations and without a superfluous word. The matter following is abstracted from the above publication:

ROCK DRILLING IN SANDSTONE QUARRIES

The two chief types of modern drills for quarry work are the tripod or bar drill and the jackhamer. The former is a reciprocating drill mounted on a tripod or attached to a bar that is supported by four legs. When the tripod is employed it must be moved to a new position for each hole that is drilled. When a bar is used, however, a line of holes may be drilled, the drill being moved along the bar and clamped successively in new positions. Bar or tripod drills are usually operated by steam.

The jackhamer is a name given to a non-reciprocating drill operated without a tripod and provided with an automatic rotating device. It employs hollow steel bits, through which the exhaust passes and blows the cutting from the hole. It gives the best service when operated by compressed air.

ADVANTAGES OF COMPRESSED AIR

It has been found in most cases that compressed air affords certain advantages over steam for the operating of quarry machinery. Where steam is used in quarries there is usually a great deal of loss by condensation, and the variable temperature in the steam pipes makes it difficult to prevent leakage. As a result of these losses the effective pressure at the machine may be very much lower than the normal boiler pressure. When air is used the loss in pressure under similar circumstances is not nearly as great. Moreover, when drills are operated by steam, water must be supplied to the drill hole, in order to remove the cuttings. This arrangement requires extra labor and keeps the quarry floor wet or muddy. On the other hand, drills of the jackhamer type may be run dry.

If steam is used for drills, and the quarry is of wide extent, it is better to have a number of boilers close to points where drilling operations are conducted than to have a central boiler house and to conduct the steam a long distance through pipe lines. Where electric power is available a portable compressor is sometimes used. It is placed close to the drill, to which compressed air is supplied through wire-wound hose. [The last sentence evidently suggests the well known electric air drill.]

The time required to move drills from one position to another in drilling rows of holes is an important consideration, especially in thin-bedded quarries, where the holes are shallow and frequent moves are necessary. In this respect the jackhamer offers certain advantages, as it is held with the hands and no adjustment of supports is necessary. In general, a better time efficiency is obtained where jackhamers are used than where tripod drills are employed.

DRILL STEEL

The nature of the drill steel is an important consideration in sandstone quarrying, as the sand acts as an abrasive and the drill rapidly loses its gage. Narrow wings wear off rapidly, and consequently the drill steel should be shaped with a view of keeping as much steel as possible near the circumference. An-

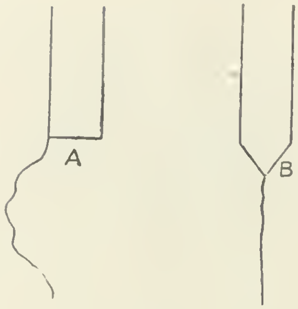


FIG. I

other important consideration is provision for adequate clearance. Most sandstone is cut rapidly, and in order that drills may give efficient service grooves of sufficent size should be provided to permit the cuttings to be removed without difficult.

Drill bushings are commonly hexagonal. It has been found by some quarrymen that square bushings are preferable, as the flat angles of a hexagonal shank wear off quickly. One company found by experience that where a hexagonal shank would last one month a square shank would last a year.

In finishing a drill hole one quarryman recommends the use of a pointed drill, in order to bring the hole to a point. This tends to promote straight splitting, for with a flat-bottomed hole the break may run off to one side, whereas with a pointed hole it inclines rather to run straight from the point, as is illustrated in Fig. 1.

RATE OF DRILLING

The rate of drilling is probably more variable in sandstone than in any other kind of rock, on account of the variable hardness. A rate recorded in northern Ohio sandstone is 38 seconds per foot for a 1¾-inch hole. In the quartzite near White Haven, Pa., holes of ½-inch diameter are drilled 3 inches deep in about 35 seconds. Thus, for holes of the same size this particular grade of Ohio sandstone is drilled about 45 times as fast as the quartzite.

THE "DITCHER" OR CIRCLE-CUTTING DRILL

In northern Ohio blocks for making grindstones are quarried in cubical form and the corners scabbled off and wasted. In certain southeastern Ohio quarries a more efficient method is employed for cutting out the circular stones. An air-driven drill of special type is employed to cut a circular trench in the quarry and thus produce blocks of the desired diameter at a single operation.

The "ditcher" is supported by tripod legs and by a vertical bar which fits into a square hole 4 by 4 inches in the rock surface. This hole is made quickly by drilling three parallel rows of three holes each with a small hammer drill, and by cutting out the intervening masses with a pick. The drilling machinery is attached to one end of a heavy crossbar, and a counterbalance weight is attached to the other end. It is rotated by a worm gear. The diameter of the circle to be cut may be varied by bolting the drill attachments in different holes on the bar. In cutting a 7-foot circle the steel is changed for about every 6 inches of depth, each successive drill being about ¼-inch smaller on account of the loss of gage by wear. A four-pointed, star-shaped drill head is employed. A sharp-pointed bar

FIG. 2

is used to trim and straighten cuts where they meet other cuts. It is claimed that a"ditcher" will cut as many square feet per day as a channeling machine. It also takes much less time to set up, as no tracks are required.

By the method used in northern Ohio square blocks are quarried and then subsequently scabbled to a round shape, whereas by the "ditcher" method one operation is saved, as they are cut in circular form in the quarry. There is also a considerable saving of material by the "ditcher" method. When square blocks are scabbled the corners are entirely wasted, whereas by using the circle-cutting device small grindstones may be cut out of the corner pieces, and the waste thereby be greatly reduced.

The drill hole for making the floor break is made by means of an air drill which slides on a horizontal bed as illustrated in Fig. 2. The drill is kept in position by the operator by means of a hinged handle and crossbar.

SAND BLAST FOR CLEANING FORGINGS*

The importance of the sand blast as an efficient agent for cleaning forgings large or small is unquestioned. Sand blast machines as now perfected give effective results in regular practice, saving time, labor and expense.

THE SAND

Where sand is used for cleaning, it is naturally a matter of constant and primary expense, with quality of grit an important consideration. Sand should be sharp and clean, free from clay and other foreign substances which go to create dust and diminish the abrasive qualities, and with necessary hardness. Further, the sand should be thoroughly dry before being used, but not overheated to destroy its strength and cohesive qualities. A coarse beach sand seems to be in general use in many instances, with grains from 1/32 to 1/16 in. in diameter. Cape May grit as well is recognized as an effective sand-blast agent.

The efficiency of a sand-blasting process depends to a large degree upon the amount of usable sand remaining after the charge, and this has led to the perfection of apparatus for separating the used and good sand from dust and dirt. Moderate air pressures lend particular assistance in preserving the sand and its essential qualities for multiplied service.

SHOT BLASTING

Shot-blasting has taken the place of sand-blasting in many forge shops, and has not only proved superior in working qualities, but in economy as well. Ordinarily, shot of a diamond formed grit is used, consisting of crushed steel or chilled iron shot, angular in shape and with all, if not more, of the cutting qualities of sand, presenting a substantial resistance to impact. This shot varies in diameter from 1/40 to /60-in., being made in different sizes selected for use in accordance with the desired finish. Shot of this nature does not break up, and being much cleaner than sand, produces less dust. Moreover, it endures much longer, a small charge of from 150 to 200 pounds being capable of constant utility for an extended period.

Forgings are cleaned in this way in from 20 to 25 minutes, having the appearance of dull nickel plate when finished. Scoured down to the metal in this manner with entire elimination of scale, the cost of further machining naturally is considerably reduced.

THE NOZZLES

The arrangement of the sand spray or nozzle in sand-blast work is a matter of no small consequence, as its proper adjustment is not only a decided factor in the proper cleaning of the forgings, but in increased output, also relating directly to the air consumption. For entirely efficient operation, forgings ordinarily seem to require a direct medium high-pressure blast action with nozzles not more than six to eight inches distant.

Nozzles through which both the air and sand mixed are shot, varying in size up to ½-in. and larger, wear rapidly, due to the abrasive nature of the sand, and this becomes a matter for constant attention. The deterioration of nozzles should not be allowed to go too far, as the increase in air consumption through this impairing is likely to become exceedingly expensive, and also reduce materially the efficiency of the machine; nozzles where required should be replaced regularly. In some shops blast outlets will last only from two to three days, while in others, employing malleable iron nozzles, a correct orifice is retained for two, three or more weeks.

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*Condensed from American Drop Forger.

AIR PRESSURES

Air pressures from 20 pounds up to 40, 60 and 80 pounds are found to give good results, the first noted being for aluminum and brass castings, the intermediate pressures for forgings and the like, and the last noted primarily for steel castings. In current practice, the average air pressure varies from about 40 to 80 pounds per square inch. Beyond these basic considerations, it is often maintained that the latter figure (80 pounds) is practically a minimum pressure for the satisfactory sand-blasting of different classes of forgings, and even still higher when available, as it will result in quicker and more economical work while, with but possibly a few minor exceptions, no possible injury to the material can ensue. In this, on the other hand, consideration must be given to the fact that the higher the air pressure, the quicker the sand is destroyed, but the actual work done depends decidedly upon the velocity of the blast.

Considerable modern equipment operating at less than 80 pounds per square inch is arranged with special motor-driven air compressors to eliminate the loss of power which is usually evidenced in utilizing any main air line installed for other plant service. This not only adds to the efficiency of the machine but reduces the cost of operation.

PRESSURE REDUCERS AND WASTE OF POWER

Allied with the subject of air pressure is that of the use of reducing valves on air lines. Loss in pressure reduction from high to low should be avoided, as after 15 or 16 pounds pressure the velocity rises very slowly. On this point one of the well-known makers of sand-blast apparatus gives a concrete example to illustrate the loss in the employment of reducing valves, as follows:

A ½-in. nozzle with air at 40 pounds gauge pressure discharges 196 cu. ft. of free air per minute, and to compress this volume of air at 40 pounds gauge pressure requires 24 horsepower. Should a reducing valve be employed on a line carrying 80 pounds pressure to reduce to 40 pounds, it would require 35 horsepower to compress 196 cu. ft. of free air, with the obvious result that the use of a reducing valve in this instance would mean a direct waste of 11 horsepower for each ½-in. nozzle.

SAND BLASTING OIL COATED FORGINGS

In the matter of heat-treated parts there is sometimes a question as to the action of the quenching oil in adhering to the material and interfering with rapid and efficient sand-blasting, due to the abrasive becoming saturated with oil or because it would seem likely to produce a sort of gummy surface, where the parts may have aged before being sand-blasted. Actual practice and results, however, indicate that this is not in any way a noticeable impediment to the speed of operation. Many cases may be found where heat-treated parts have been taken directly from the quenching bath covered with oil and subjected to the sand-blast, with the sand capable of use again and again during a period of from three to four hours.

HOW THE SAND BLAST PAYS

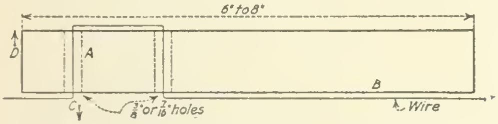
The sand-blast makes possible an average saving of 25 to 50 per cent. in tool upkeep and machinists' time; it not only speeds up production, but insures the delivery of a perfectly clean forging. Beyond this the appearance of the forging is improved, the defects are uncovered and the expense of useless machining is avoided. And all of this naturally infers a better price for the product. That the sand-blast machine is the best, quickest and most effective way to clean material of this nature is continually being demontsrated in actual practice in many forge shops.

PROTECTING THE WORKMAN

The former dangers to workmen have been minimized by correct installations for dirt and dust removal. In recent years this subject has been given wide attention. Arrangements are now possible with different types of perfected control apparatus, to make constant change of air every two to five minutes or more to insure proper conditions in sand-blast rooms, as well as to provide for the efficient removal of dust and dirt, as sand-blasting at best is not the most desirable of shop operations.

Sand-blast helmets, gloves, goggles and similar apparatus also have been perfected to a fine point to make sand-blast work possible with proper operating environments, and eliminating unfavorable conditions existing in the earlier days. Respirators are available for use when adequate provision for exhausting dust from the room is wanting. Operators' hoods, as well, are in service, such being connected with a low-pressure air supply line to maintain them free from dust particles. That it is to an employer's advantage to adopt such equipment is hardly to be mentioned in the case of the progressive shop, as it naturally brings far better and more beneficial service and results in the full accomplishment of maximum production, at the same time eliminating the dangers of unhealthy working quarters for the operator.

The selection of equipment is of particular importance for the proper scouring or cleaning of forgings. The right machine for the desired service is necessary for greatest efficiency, and careful consideration should be given to different types of machines and their qualifications to bring about an installation of advantage, profit, and utmost utility for the forging work and plant service to be accomplished.



HAMMER HANDLE FOR WIRE WINDING

TIGHT WIRE WINDING HOLDS THE HOSE ON THE FITTING

Some time ago the writer was employed in repairing riveting machines and their appurtenances for a gang of riveters on tank work. All the rivets were driven cold, the men were all paid by the piece and strike conditions prevailed. The wear and tear on equipment under these circumstances was very severe, but in no place was it more marked than in the way the fittings were constantly pulling out of the tail or buck hose. We are carrying 110 lb. air pressure on the lines. and this, coupled with rough handling, would pull out fittings some days faster than a man could put them in. All sorts of patent clamps were tried, but none proved equal to this job.

I was about to give up in disgust when one of the gang told me of a tool that solved the problem in the neatest way that I have ever seen during 15 years of construction work.

He took a hammer handle, sawed off a piece 6 to 8 in. long, then bored two ⅜ in. holes through it; the first ½ in. from the end of the handle, the other parallel and approximately 1 in. further up the handle, as shown in the sketch. He then pressed the end of a wire of about 16 gage through the holes, as shown below. The wire was pulled through hole A until 4 or 5 in. protruded. It was then clamped in the vise along with the fitting which had been previously forced into the hose, and the wire was then tightly wound over the hose, the tension being regulated by lightly holding the wire against the handle, with the hand at B. Having the wire and hose clamped in the vise, my man commenced to wind the wire down the length of the fitting as tight and close as ever a wire was wound on a spool; then back with three or four turns to the starting point, and there the two ends were twisted together with pliers in the ordinary manner, and the job is done to stay. It is hard to believe what an enormous pull can be exerted on that wire. In fact, the novice at his first attempt will probably pull his wire in two several times before he gets the correct notion of the pull he is exerting. But in no case will the fitting ever again pull out. In hundreds of cases I have never known a blow-out. Neither use, pressure nor abuse has any effect on a joint well made in this manner —the hose always wears out first, before the fitting gives trouble.

This work was all done on ¾ in. and 1 in. hose, but there is no reason why it should not do for any size, or, in fact, in any place where it is desired to do a snug, tight job of winding wire. The convenience of the tool is further enhanced by the fact that it is cheap, can be made anywhere, any time, by anyone, and can always be depended on to do a tight, neat job.—*H. B. McDermid in Engineering and Contracting.*

LINCOLN HIGHWAY AND LINCOLN AIR WAY

Cross-country flying over the Lincoln Highway is expected to be the first result obtained in the movement of developing aeronautics in this country. Air craft abroad have been brought to a high state of efficiency in the past two years, and tremendous possibilities for them are promised by those in authority. Commenting on the situation Lieut-Col. George O. Squires, U. S. A., head of the aviation section of the army, says: "It occurs to me that since we have the Lincoln Highway laid out for automobiles, why couldn't we go along that same route and have reserve landings with gasoline and mechanics and 'first aid' in each of these reservations, so that one can start across the continent and have a Lincoln Airway over the Lincoln Highway?"

WIND POWER

BY W. H. BOOTH

Is it worth while to utilize the wind except for small country work? This is doubtful. A few years ago a modern type windmill was set up in London to generate electricity, a special throwover switch being employed between the driven dynamo and the electrical storage battery, so as only to utilize the mill's effort when this was equal to the required voltage. Experience has shown that even the makers of windmills are strangely ill-informed on the principles upon which they work and of the power they should generate.

If a wind blows at a velocity which shall be called 1, and a given mill performs 1 horsepower with that wind, why should it do eight times as much work with a wind of a velocity of 2? Many men will say that the work varies as the square of the velocity of the wind, but the true ratio is theoretically as the cube. To prove this let a time of one hour be taken. Then in the first case a length of one mile of air passes the mill in one hour. In the second case, the velocity being double, there will be two miles of wind passing. But the energy in a moving body varies with the square of the velocity. Each of the two-mile lengths of wind has 2 times the energy of a mile of one-mile wind. Therefore, 2^2 must be multiplied also by the weight of ratio passing in unit time, and the final power ratio is as $2^2 : 2^3$, or 8.

Rankine, who treated on windmills, was not very clear in his statement of efficiency, for he speaks of the cylinder of wind in which the mill revolves as though he had the full face of the mill in mind, and not merely that fraction of the face, usually 60 to 70 per cent. of its area, which is occupied by the sails. This fraction alone is acted upon by the wind. The actual energy in the wind per pound is represented by the expression, $E = v^2 \div 2g$ where $v =$ the wind velocity per second, and $g = 32.2$ or gravity, E, being in foot-pounds. The weight of air which comes into the calculation is about one-thirteenth of the area of the mill sails multiplied by the velocity of the wind and feet per second. The area of sail is of course the area on a flat surface, not the actual area of the inclined sail. Having found the theoretic form, not more than a fourth should be accepted as brake horse-power, and about half this as pump horse-power. A pump ought to do better than give a 50 per cent. efficiency, but experience of actual windmill pumps has demonstrated so much bad and inferior work that it is unsafe to count on more. To begin with, the pump rod gland is not apt to be liberally proportioned, and it must either leak or be too tightly screwed up, as to which more anon. Pump barrels are not always bored parallel, and a bucket without load on it and only about 4 ins. diameter has been known to grip its barrel so tightly as to require a pull of 140 lb. to move it. A windmill pump ought to have a solid grooved bucket of great length, so as to be frictionless. It must be larger than an ordinary pump bucket, because it has so short a stroke and so slow a movement, at times, that if not run long it would pass too much water by way of its water packed grooves. Very many windmills are made single-acting as to the pump. There is no harm in the single-acting pump if this is balanced. But very often it is not balanced, and herein lies the secret of the leaking gland. The mill cannot start the pump on a working stroke with a light wind. Once stopped, the mill can only start again when the wind blows strongly. So the gland is made to leak, and a light wind can tug at the bucket, and force water through the leaking gland until the barrel is empty, and away runs the mill merrily on the down stroke, and accumulates energy to help it up the up stroke. This is bad engineering, and single-acting pumps ought to be balanced by means of balance weights placed high, near the mill crank, unless the mill is one of those which drives by bevel wheels and a vertical shaft.

Too much should not be expected from a windmill, and for this reason the work should be balanced, and the machinery to be driven should be carefullly and accurately made in order to secure the best possible efficiency. Only thus can the best be got out of the mill, for with such care the mill will not only do better from the fair winds, but will utilize winds that would not move a poorly made mill or pump overdone by packing—developed friction.

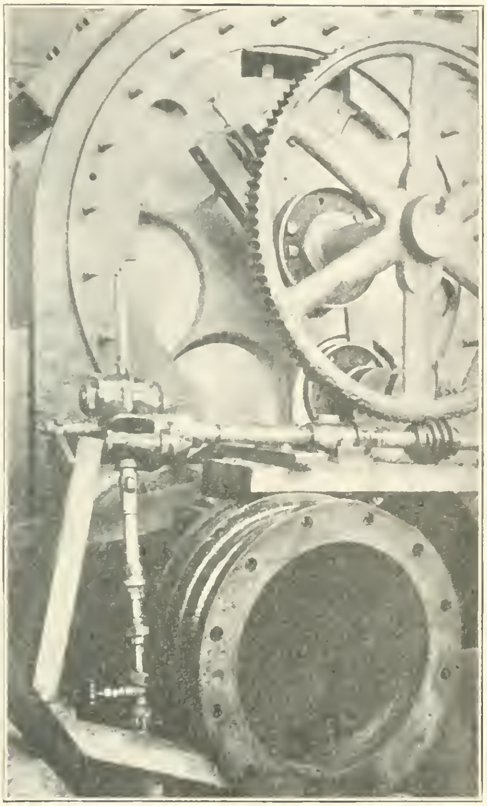
The windmill as a very serious small power hardly deserves so much notice as above given to it, and is often used where it would be better to employ an electric motor. For small house water supplies the windmill will serve very well if arranged in conjunction with a large storage tank. Usually a windmill will work eight hours a day, but it may frequently happen that it will stand idle two or three days in succession, and the worse the mill is in respect of balance and workmanship the less it will do in light winds. As soon as a serious amount of work is demanded, the utmost caution should be exercised in deciding upon wind as the motive power. In a country house there should be at least a week's storage of water, for though it may be true that a mill will do an average of eight hours' work per day, some of this average is made up of sixteen-hour days, and there are very short days in between.

THE REVOLVING DOOR FOR THE SAND BLAST ROOM

Devices for the protection of the sand blast operator are continually developing, each having its special adaptation to certain conditions. The revolving door in familiar use for the entrances of public buildings has been found of value for placing work in the sand blast room and sucessively removing the same without interruption of operation. The quadrants of the floor formed by the angles of the wings are converted into shelves, revolving with the door, and upon these are placed the articles to be sandblasted. When the door is given a half turn and the articles are exposed within the chamber, blast jets play upon them directed by an operator outside the room on the other side, who looks in through a screened window.

CEMENT GUN SAVES A BIG CHIMNEY

An old octagonal brick chimney 125 ft. high and 12 ft. diameter, belonging to the Solway Process Company, Detroit, had become badly weathered so that large quantities of mortar had fallen out of the joints and much of the brick was eaten away to a depth of several inches. The exterior surface was first cleared by the removal of all loose material and then the entire structure was enclosed by triangular wire mesh furred out about 1 in. all around and upon this concrete was shot by cement guns forming a solid mass with a minimum thickness of 2 in. The air pressure employed was 50 lb. and the cost of the job about $1500.



A "LITTLE DAVID" DRILL BORES A BIG CYLINDER

The half tone above illustrates the facility with which pneumatic tools may be applied to various uses other than those for which they are normally employed. The photo comes to us from a gold mine in Canada and shows how a "Little David" pneumatic drill was connected up for driving a big boring bar. The air compressor cylinder which is being rebored is 38 inches in diameter. The drill spindle, it will be seen, is connected directly to the worm shaft, which gives it the necessary advantage in power and also produces the required slow rotation for the cutter head. It would seem to be quite unnecessary to say that the job was a complete success both mechanically and also in the saving of expense.

Japan built her first locomotive about two years ago, and now she is exporting locomotives. Recently she sent two to Saigon, Cochin China, for the French Railways there.

PARADOXICAL CARBON MONOXIDE

BY CHARLES S. PALMER

This is a story about one of the queer things that are continually happening in the limitless field of chemical discovery; for, if the dear public only knew it, there is more of the novel and sensational in the good Journals of the American Chemical Society, than there is in the last war bulletin or the last "thriller" of the best-selling novel.

This story has to do with what the chemist calls "carbon-monoxide," for short. This carbon-monoxide is a very common substance, and a weird chemical paradox. It is a colorless gas, without any decided taste or odor, but with an inherent antipathy toward human life; that is one side of its character. The other side is that it is probably a common go-between in that wonderful alchemy, whereby the green chlorophyl umbrella of green leaves, and the sunlight, play their continual duet of reducing the carbonic acid of the air, to the sugar-like substances on which animal life of the globe depends. And that is quite enough of a proposition for one small substance to tackle.

Now, in a way, we are familiar with this witch, carbon-monoxide. It is the stuff which burns with that beautiful blue-green, or green-blue flame in the bottom of the humble candle flame. It is the same stuff which shows the almost colorless flame when fresh coal is added to a fire. It shows well in the common gas range, with the same blue-green flame.

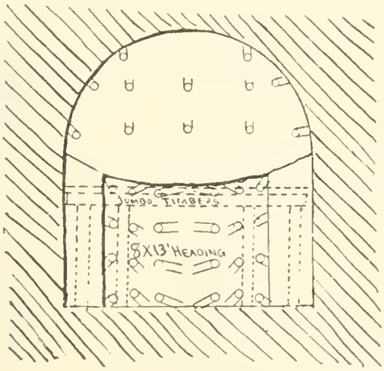
We are also very familiar with the same gas, when it furnishes our papers with the laconic note that Mr. So-and-so committed suicide by "turning on the gas" and forgetting to turn it off. For this carbon-monoxide is a large part of common city gas, especially when it is what is called "water-gas"; and this water-gas would work deadly havoc with civilized humanity were it not for the fact that to get common gas to give light as well as heat, it is customary to "carburet" the gas with some cheap oil; and as this cheap carburetting gas is itself bad smelling, and gives common city gas most of its bad ordor, it also serves to warn careless humanity when "the gas is leaking." And so it comes about that water-gas, though very poisonous, on account of the large quantity of this same carbon-monoxide gas, actually poisons very few people, because the dangerous leak is so well and promptly advertised by the bad smelling carburetting gas. Thus we are, albeit unconsciously, very closely associated with the heroine of this story, the tantalizing carbon monoxide.

But now the strange part of this narrative comes in. If this carbon-monoxide gas is so common in such common processes as the burning of coal on the one hand, and in the reduction of carbonic acid gas on the other hand, why does it not accumulate in some corner of Mother Nature's laboratory? Why should we not find it in convenient hiding in a thousand places? Why should we not run across it every now and then—not in the animal world, for it is really poisonous to most animals, perhaps to all—why should we not find it at least quite common in some nook of the vegetable world For the fact is, and we have told it by our series of queries—the fact is that this carbon-monoxide gas has not been commonly found in the vegetable world. And that is all the more strange, because the air food of most green plants must go through a stage where it is something very much like carbon-monoxide. Perhaps the real reason is that we do not yet know that this witch, carbon-monoxide, is not very common in plants, green plants particularly. And back of that statement is another which one might make with a large degree of safety. Perhaps it is not known to be common because it has not been looked for. For it is a curious fact in chemical progress, that there are lots of things which are not found till they *are* looked for, in the hide-and-seek of inventive carelessness. A similar thing was true of the finding of argon and its attendant throng of inactive elements in common air. Though the first facts which, if followed up might have told our great-great grandfathers, were known, yet they were not followed up, till another set of facts forced the issue—and so argon and her attendants came out into the open. A somewhat similar thing was true of that sensational element, radium; though, when it was once well guessed at, it still took many months of fractioning out to get even a microscopic sample of the most revolutionary element of all—radium. But this is not the story of radium.

The finding out of one hinding place of carbon-monoxide came about in a curious way. We do not need to be told that one result of the war has been a marked scarcity of potash compounds in all countries, except Germany, which has vast stores of potash in connection with her salt mines. Now, it was a side hunt for potash which brought out the knowledge of one lurking place of carbon-monoxide. Among the many places where our chemists looked for potash compounds, was in the ashes of sea-weeds; and it was in one of these floating vegetable unused wastes that a most interesting discovery was made. It came about in this way:

In getting out a report on the possibility of the economic extraction of potash salts from sea-weeds, a careful survey was made of the chemical composition of all parts of the large "kelp" sea-weeds of the California coast. And, further, in this chemical survey, it was noticed that some of the kelp plants contained large quantities of a mixed gas. Now in the analysis of this gas from one kind of gigantic kelp on the California, or rather, on the Washington coast—a brown alga, which modestly tolerates the name *Nereocystis luetkeana,* this carbon-monoxide was found. This kind of kelp is said to grow with stipe, or stem, or stalk of from fifty to eighty feet in length. These stalks are hollow, from the bulb-like top, to the "hold-fast" at the bottom. "The walls of the stipe are from a quarter to three-quarters of an inch in thickness, and are lined on the inside with a delicate web-like structure which is relatively quite dry. This hollow space, in large specimens, has a capacity of from three to four liters"—that is several quarts. "The gas is almost always under less than atmospheric pressure." There it is, the hiding place, or one of them, of this chemical dryad of the vegetable world—the air spaces of the stems of this giant seaweed of the Pacific coast.

Now this gas from this corky stem substance of this kelp had been analysed before; and oxygen, nitrogen and carbon-dioxide had been reported; but not carbon-monoxide—till one Seth C. Langdon of the State University of Washington at Seattle, noted something irregular about the method and results of the analysis of the gas. Then, on making a careful and complete analysis, Professor Langdon found that this same poisonous gas—poisonous to animals—was contained in this sea-weed gas in quantities from one to twelve per cent. And this is no small quantity, for it was enough, not only to show all the chemical tests, but it was enough to kill canaries, chickens and guinea pigs, when placed in the gas. Of course the gas was drawn off from the sea-wood in large quantities; and its identification is beyond dispute. Professor Langdon has placed the whole world of both chemists and curiosity hunters under lasting indebtedness for his novel and surprising, and yet wholly natural, discovery. It is gratifying to know that Mother Nature does not only use and make, but also that she actually stores up, notable quantities of this paradoxical gas, carbon-monoxide. This is said to be the first time that such an occurrence has been noted for the vegetable world; and yet, most of us might say: "Well, why not?" Of course, but all the same, it is a decided step in "The Advancement of Learning."—*Scientific American.*



LAYOUT OF DRILL HOLES

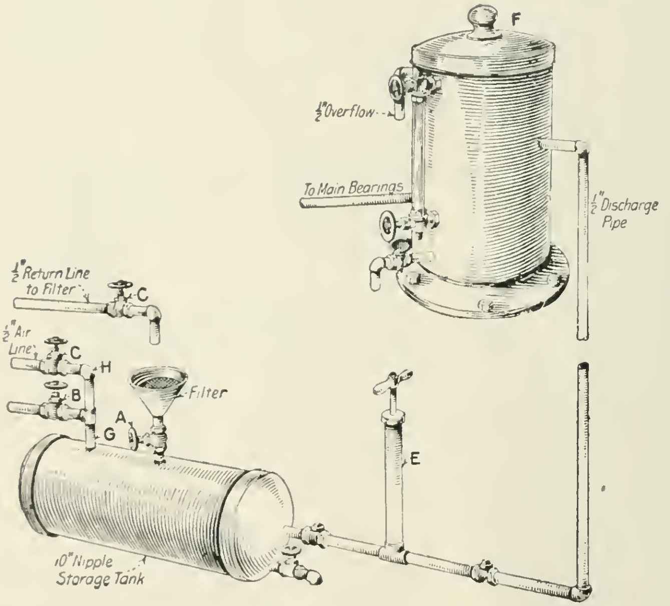
TUNNEL DRIVEN WITH BOTTOM HEADING

About 5000 ft. of the Mill Creek, Missouri, sewer tunnel, was driven through solid limestone rock by the James E. McMahon Construction Co., St. Louis, who used the bottom heading method and secured an average progress nearly twice as great as that attained by two other contractors who used the top heading method on other sections of the same tunnel under similar conditions.

The 8x13-ft. heading was drilled with 22 to 24 holes from 7 to 9 ft. deep loaded with 60 per cent. dynamite detonated with No. 6 caps and giving an average break of 4½ ft. per shock. Four or five shots were fired in two 10-hr. shifts, requiring about 4lb. of dynamite per yard for the heading and about ½ lb. per yard for the breakdown and wings.

The average progress of the heading was 16 ft. in 24 hr. and the best record was 114 ft. in one week.

Jumbo timbers were set up in the bottom heading to receive the rock from the top heading which was broken down with twelve holes and the material dumped through holes in the jumbo platform into muck cars on the floor of the bottom heading. By this system work on the breakdown and wings was carried on simultaneously with the bottom heading.—*Contracting.*



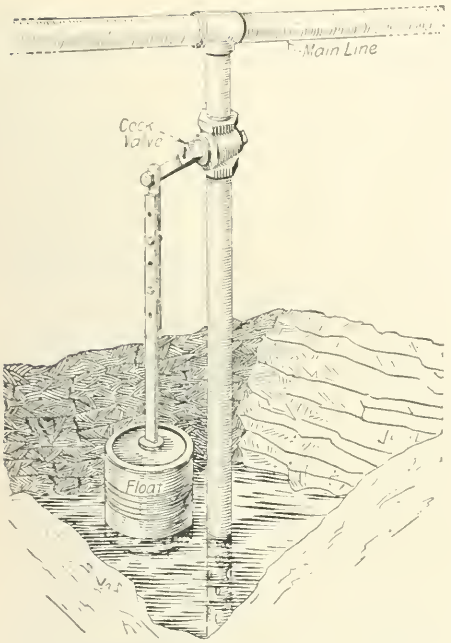
HANDLING OIL BY COMPRESSED AIR

The sketch shows a convenience that I applied to an engine recently, which may prove valuable to others. This engine was not provided with means for returning the lubricating oil to the overhead tank. We first made a filter tank, using a 10-in. nipple 24 in. long and two caps; holes were drilled and tapped for the pipes as shown. Having a branch of the factory compressed-air system in the engine room, we piped it to the tank at *G*, so that when the tank *F* is becoming empty and the filter tank is filling up, all that we have to do is to close the valves *A* and *B* and open the air valve *C*, In about ten seconds the oil is transferred from the lower to the upper tank. Then, by closing the valve *C* and opening *A* and *B*, the lower tank fills again. A hand-pump *E* was put in the discharge line for use in case the air supply should fail. If the facilities for making the hand pump are not available, a tee may be fitted at *H*, to which an ordinary automobile tire pump can be connected.—*William Hays, Indianapolis, in Power.*

CHLORINE AND TYPHOID

It is positively amazing that only two or three pounds of liquid chlorine, costing about 16 ct. a pound, will kill all the typhoid germs in a million gallons, or more than eight million pounds of water. Picture to yourself a pint of liquid chlorine and a reservoir of water 8 ft. deep, 20 ft. wide and 400 ft. long, containing 4,000,000 lb. of water. Pour this pint of chlorine into this great tank of water and mix it up. You will be unable to see, taste or smell the chlorine thus diluted, but every typhoid germ will forthwith "curl up and die." Talk about homeopathic dosing! The ghost of Dr. Hahnemann must turn green with envy every time the valve of a chlorinator opens to vent its tiny droppings. Think of it! One drop of chlorine in two barrels of water puts Mr. Microbe permanently to sleep.

Every year 300,000 Americans are incapacitated by typhoid and 20,000 of them die. Bring these figures home to yourself. Imagine every citizen of Seattle, or of Indianapolis, being compelled to suffer for weeks every year from this terrible disease; and then, in your imagination, follow 20,000 hearses to the grave. What you thus imagine is the numerical equivalent of what actually happens every year. And it is a preventable happening, preventable at a cost so low that nothing but gross ignorance accounts for our failure to act. Resolve to do your part to eliminate this ignorance and its consequent suffering.—*Engineering and Contracting.*



AN AUTOMATIC SUCTION CONTROL

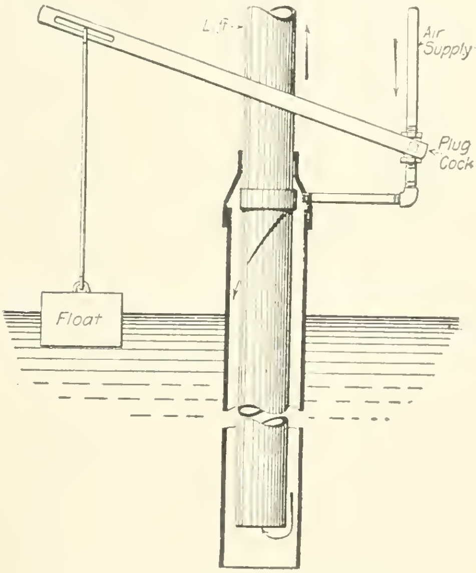
At some mines where several pumps are required, each drawing water from several sumps, unless some kind of automatic suction-control device is employed more than one pumpman will be necessary to keep all the pumps in efficient operation.

The accompanying illustration from *Coal Age* shows a device useful for governing the flow of water from the various sumps to a single pump. It consists essentially of a cock in the sump suction line, a float in the sump and a suitable rod and lever connecting the two. When the water in the sump rises, the float opens the cock; when it falls, it closes it.

For a float an old powder can may be used. The hole, of course, is first effectually sealed after which the can is given a good coat of paint. This answers the purpose fairly satisfactorily. By means of the above-described apparatus several sumps may be kept pumped out without the continuous care of the pumpman.

HUMIDIFYING THE OVEN ATMOSPHERE

H. H. Dunn, industrial engineer of the Roanoke (Va.) Gas Light Company, recently undertook the devising of gas equipment to melt butter on turn-over buttered rolls without making them crusty. He started off with confidence as the task seemed simple, but found the problem more difficult to solve than it seemed. Aften ten days of effort he solved it by installing one-hole hot plate on which was placed a small single Elgin oven in which the rolls are placed to melt the butter properly. On top of this oven he placed a number 20 Ideal Steam Cooker with wire shelves. With a small amount of water in the pan, the heat from the oven in which the rolls are placed to melt the butter just gives the proper amount of moisture by being placed on top of the Elgin oven and keeps the rolls from becoming cold or soggy.—*Am. Gas Eng. Journal.*



AIR LIFT FOR SLIME PULP

BY A. W. ALLEN

The accompanying diagram illustrates a type of air lift installed recently in South America for the first stage of a compound lift to handle slimed-ore pulp. The second lift was of the ordinary type with compressed air delivered into the bottom of the lift in the usual way. A comparison was therefore possible as conditions were equal, and results obtained were all in favor of the type illustrated. The dimension of the lift pipe was 3½ in. and of the air pipe, 5 in. The 5-in. pipe was carried just above the level of the pulp and was connected with the lift pipe by a 5x3⅓-in. reducer. It extended about 2 in. below the level of the lift pipe —*Power.*

AIR JET CLEANS PIPE PILES ON PHILADELPHIA SUBWAY

A three-inch jet nozzled down to 2 in. is being used under 100 lb. pressure to clean out sand and gravel from the pipe piles being driven in Philadelphia to support the walls of the City Hall station of the new subway. The piles being filled with water, the jet acts as an air lift, blowing the sand and gravel out of the top of the pile with considerable velocity into the underpinning pit. While one pile is being cleaned, it is necessary to cap the others driven in the same section to prevent filling them. The piles, which average 18 or 19 ft. penetration, are driven several feet at a time and then cleaned out with the jet to the bottom. Care is taken not to allow the air jet to get below the bottom of the pile, for fear of drawing in material from beneath the building. With one or two piles which stuck, however, it was possible to start them again by cleaning out 6 or 8 in. below their bottoms. After the piles reach rock, the jet is again put in and cleans out the pipe perfectly, removing everything except the hard rock. The jets are not worked into the material, but simply lowered until they touch the sand, when the pressure is turned on full force. The dirt that is blown out of the piles is cleaned out of the wall pits later by shoveling it into buckets.—*Eng. News-Record.*

WATER PRESSED BY AIR INSTEAD OF PUMPING

Having on hand two sheet-steel tanks of 29,000-gal, capacity and an air compressor with plenty of off-peak time, the designers of the Lawrenceville, Ill., filter plant were enabled to eliminate the purchase of a wash-water pump, the compressor being available to store up sufficient air under pressure on top of the water to wash the filters.

The plant, which has only recently been put into operation, consists of two rapid filters of 180 sq. ft. filtering area each, with the usual system of strainers fitted for washing at a rate of 2 ft. vertical rise per minute, with water only. The two long horizontal tanks alongside the filter building were formerly used on the distribution system as storage tanks and pressure equalizers. The engineers considered it advisable to use these tanks since they were available, rather than to scrap them and purchase a large pump and possibly an air blower, both of which would stand idle much of the time.

In washing a filter the procedure is as follows: Starting with the tanks three-fourths full of water, air is pumped in through a 2-in. line until a pressure of 25 lb. per sq. in. has been attained. The air line is then shut off adjacent to the tanks, and the compressor fills an air-storage reservoir of 340 cu. ft. of free air to a pressure of 80 lb. per sq. in. This storage is on the air line leading to the wash-water tanks. When the required pressure is attained and the storage opened into the line, the filter wash is started. By proper manipulation of the wash-water valve an even wash can be maintained at the required rate. When the filter has been washed, the air pressure is released and the tanks refilled from city service. The only objection reported to the procedure is that the operator may be careless and not give proper attention to the manipulation of the wash-water valve, in which event it is possible to blow up the sand bed.—*Eng. News-Record.*

SCIENTIFIC DEDUCTION OUTSTRIPS IMAGINATION.

In the *Journal* of the British Astronomical Association for November, 1916, Mr. Edwin Holmes criticises the following statement of another member of that Association: "A planet in such a condition" (as Jupiter) "must *necessarily* have a dense and deep atmosphere."

After referring to an investigation by Mr. E. W. Maunder of the circumstances which settle the heights of planetary atmospheres, Mr. Holmes says: "We must not forget that on Jupiter gravity doubles the pressure (or halves it) every 1.6 miles. M. Flammarion calculated that if his atmosphere had a depth of only 100 kilometers, or about 63 miles, the density at 37 miles from the surface would be the density of platinum, 'and yet there are 25 more doublings of density in the remaining descent.' He adds: 'It is perfectly monstrous.' The atmosphere at the surface would be 17 millions of times more dense than platinum. I think this amounts to telling us that long before we reached even 37 miles down, the atmosphere would be compressed into a solid body and would be in no reasonable sense an atmosphere at all.

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UNNECESSARILY VULNERABLE

The state of actual war which now exists, with a foe alert, resourceful and unscrupulous, has set us to studying our defensive weaknesses, and to devising schemes for our safeguarding against the too evident possibilities of disaster. It is not easy to compute the derangement which might be caused by a single fortunate (?) hit by a shell of high explosives from a long range gun, or by a single charge of dynamite judiciously placed by traitor or spy.

New York City, for instance, or let us say Manhattan, has practically no sources of potable water within its limits, and if the continuous inflow should be stopped what could become of its crowded millions? No hasty surrender to any foe could avail to save it from incalculable horrors. It has been impossible for us not to think of the terrible consequences which would follow the cutting off of our water supply, and very properly arrangements have been made for policing and guarding watersheds, reservoirs, aqueducts, gatehouses and the distributing system in detail. We are fortunate in being able to believe that the perfectly possible catastrophe is very far from the probable.

While apparently everybody has thought of the possible danger of water stoppage, why has there not been an equally prompt and general apprehension concerning our municipal gas supply? We are not suggesting that the stoppage of our gas would be a catastrophe commensurate with the stoppage of our water supply, but still it would be sufficiently serious. Illuminating gas we have been in the habit of calling it, and such it still is, but its now most indispensable function would be much more correctly characterized today by calling it cooking gas. Not only is three-quarters of our domestic cooking done by gas but we have no available substitute. Stoves have generally disappeared in flats and apartments and we have neither the fuel nor the means of burning it. We couldn't boil an egg or make a cup of tea, to say nothing of frying, broiling, roasting or baking, and who could live without these necessary services?

And then it is so easy to knock out the gas service. Our district gas holders are the most conspicuous objects from a distance and ideal targets for long range gunners, a single hit in every case sufficing for their complete incapacitation, whether from a gun or from a hand placed bomb.

We do not take to ourselves any reprehension for calling attention to this matter and thus suggesting possibilities of mischief, because the opportunity is too self-evident to have been lost sight of by those who are looking for chances to make trouble. We may in fact do good rather than harm by calling attention to a danger to be guarded against.

But the aggravating thing is that this danger is one absolutely unnecessary to be incurred. The gas holders and the system which employs them are wrong throughout both in peace and war, and should for many reasons be discarded.

As natural gas is distributed at pressures which make the local gas holder impossible, there is no reason why "manufactured" gas cannot also be distributed in the same way. There is no imperative reason for the gas holder except for storage at the gas works, and even there it might be down in the ground instead of up in the sky. The flow service could be maintained by compressors and, as has been amply demonstrated, gas served at higher pressures would give more satisfactory results.

SCARCITY OF COMMON SENSE

The second edition of the work on Compressed Air by Professor Elmo G. Harris, of which we desire to speak only in terms of high commendation, reproduces the preface to the first edition in which occurs the following, to us, amazing paragraph:

"As one advocating the increased application of compressed air and the more efficient use where at present applied, the author has prepared this volume for college-bred men, believing that such only, and only the best of such, should be entrusted with the designing of compressed air installations."

In reply to this we have no word of deprecation for college-bred men, but we do protest that they are no more absolutely requisite for compressed air installations than for steam installations, for electric installations, for water pumping installations, for railroading installations or anything else.

We are quite willing to say that for all such installations a greater prerequisite than college training is mechanical common-sense, engineering common sense, or just common, every day common sense.

As narrated in a recent issue of the *New York Herald*, a young man went to England at the beginning of the war and entered the Royal British Flying Corps. A year ago he was flying at the front carrying important messages to London and return, having developed into a most skilled air pilot. Returning to this country he was recently rejected from our aviation service because he had not the college qualification. Another case where common sense seemed to be out of service.

THE MARIETTA COMPRESSED AIR PROCESS FOR OIL WELLS

The Smith-Dunn or Marietta process for increasing the production of wells in an old field by forcing air down one well among a group was discussed by J. O. Lewis of the U. S. Bureau of Mines at a recent meeting of the Petroleum Club of the University of California. This method was developed at Marietta, Ohio, and is now used extensively in the Appalachian fields and also in some of the Okalhoma fields. Where it has been successful, the average increase of production has been 300%, and in some cases as great as 900%. It should, however, be stated that the average production of wells in the districts where the process has been used is less than one barrel per day.

Where the method is used, one producing well in a group is selected as an air-well. Best results are usually obtained when there is one air-well to three pumping wells. The air is forced down the air-well through a string of tubing with a packer at the end. It is important that the air does not have access to the stratum above the oil-sand. The pressure used is about 150 lb. per sq. in., varying somewhat with local conditions. From 5000 to 20,000 cu. ft. of free air per well per day is needed. The pumping-wells are operated as usual, either by jacks or on the beam.

The air takes up the volatile constituents of the oil in the form of vapor and is caught and used in the gas-engines required to operate the property. It is possible that this air might be used successfully for making casing-head gasoline. The first effect of the use of this process is an increase of gas from the pumping-wells. Then follows an increase in water, and finally an increase in the oil production. Frequently the full effects on the oil production will not be seen for several months. There is also an increase in the amount of sand. The cost of installation is from $100 to $150 per well. There is also an increased cost of maintenance of from 25 to 50%. This process is sometimes used in connection with vacuum-pumps on the producing-wells, but since the limit of vacuum is about 10 lb., most operators prefer to carry more pressure on the air-compressors.

BLOWING WELLS

What are known as blowing wells are described by the United States Geological Survey, Department of the Interior, in a recent letter to a correspondent.

"Blowing" wells, also known as "breathing," "sucking," "weather," and "barometer" wells, it is stated, have been reported from many localities. When such wells have been carefully observed it has been found that the blowing and sucking occur alternately—that is, at certain times the blowing is outward and at intervening periods it is inward. It has been found that the phenomena are due to differences in atmospheric or barometric pressure. The necessary conditions seem to be a porous stratum, such as sandstone, gravel, or porous limestone, only partially saturated with water, overlain by some impervious substance such as shale or clay. While the atmospheric pressure is high the air enters the well and collects in the upper part of the porous stratum above the water level. While the barometric pressure is low the air is expelled with considerable force, producing what is known as "blowing." This blowing frequently occurs during storm periods or when the wind is in a certain direction or during certain periods of the day.

VOLATILITY OF CASING-HEAD GASOLINE

An important factor in the market is the so-called casing-head gasoline, which is extracted from natural gas by compression or scrubbing. It consists of hydro-carbons of low boiling points and when unmixed with other products is extremely volatile. This product must be stored and handled with care in order to avoid exaporation losses. Casing-head gasoline is rarely or never used "straight," being generally mixed with enough heavy naphtha to bring it to the proper specific gravity. The tendency to evaporate is incidentally reduced, but still remains greater than that of a straight refinery product of approximately the same specific gravity.

Blended casing-head gasoline is an important factor in present market conditions and is not necessarily inferior to "straight" refinery gasoline. Although the tendency to evaporate is great there is an advantage in the fact that blended gasolines undoubtedly "start" with great ease in an engine. In addition it is claimed, with what seems perfectly sound logic, that the hetrogeneous character of this gasoline slows down the velocity of combustion and results in maximum pressure being developed with a gradual push on the engine piston rather than with a sharp explosion. This results in the development of maximum power with a minimum of strain from high pressures. No data are at hand to support the claims generally made by producers of blended casing-head gasolines, but the contentions stated seem reasonable in theory.

It is possible by means of a distillation to distinguish blended casing-head gasoline from ordinary refinery products because the volatility range of the former has more or less definite general characteristics.—*Walter F. Rittman.*

THE ENGINEER SALESMAN

BY GEORGE P. BALDWIN

The first requisite for a successful sales transaction is a scientifically designed and well manufactured product. The next element is the salesman's intimate knowledge of this product and its application; and the third and most important feature as far as the commercial engineer is concerned is his ability to establish and maintain favorable relations with the people with whom he is brought into contact. It is this ability to establish favorable relations and maintain them that produces results and for which the engineer who desires to enter the commercial field must train himself. He must have not only sound engineering knowledge, but must also supplement this with a well-rounded-out knowledge of men, and affairs in general; this latter feature is important and, strange to say, is often lost sight of by the young man.

A man who is now a prominent executive in one of our engineering organizations nearly marred his career because of his neglect to realize this. The great turning point came when he was offered the position of Treasurer of his company. He hesitated. He considered it unfortunate. He feared he would no longer remain an engineer. Yet he finally yielded to exterior pressure and accepted the position. Later developments proved, without question, that this was the best step he could have made for it broadened his vision. Since he has crossed the threshold into the commercial world he has been able to make use of his engineering knowledge in a vast number of diverse fields. Today he is amazed at the ignorance which caused him to hesitate.

His successful career is an example of what can be done today in commercial engineering. The old school salesman has passed. The salesman of today must thoroughly know his subject. If he does not have a deep knowledge of engineering principles and their application as well, he may try to get business by means of guessed-at statements; or should he not yield to this temptation, he will find himself often in the position where he must confess his ignorance in the presence of the prospective customer and offer to send to the home office for an engineer. The doctrine of the survival of the fittest is rapidly eliminating this type. Today, the great manufacturers realize that the man to get the business should really be an engineer and be able to discuss intelligently the topics under consideration in all their phases. It has been proven that the old method was economic waste; the new method is modern business.—*General Electric Review.*

NEW BOOK

COMPRESSED AIR. THEORY AND COMPUTATIONS. By Elmo G. Harris. Second edition, revised and enlarged. McGraw-Hill Book Company, Inc., New York. 206 pages 6 by 9 inches, 32 cuts, numerous diagrams and elaborate tables. Price $2.00.

This excellent work has deservedly and properly attained its second edition. It is an ideal book for college use. For the student of compressed air theory and for the seeker of precision in practice it is indispensable. Errors and ambiguities of the first edition have been eliminated and valuable matter has been added. There is a new chapter on centrifugal fans and turbo compressors and an appendix on the designing of logarithmic-charts.

NEW PUBLICATIONS OF THE BUREAU OF MINES

Coal-mine fatalities in the United States, 1916, compiled by A. H. Fay. 1917. 42 pp.

BULLETINS

Bulletin 119. Analyses of coals purchased by the Government during the fiscal years 1908-1915, by G. S. Pope. 1916. 118 pp.

Bulletin 143. Abstracts of current decisions on mines and mining, reported from May to August, 1916, by J. W. Thompson. 1917. 72 pp.

TECHNICAL PAPERS

Technical Paper 87. Methods of testing natural gas for gasoline content, by G. A. Burrell and G. W. Jones. 1916. 26 pp., 7 figs.

Technical Paper 106. Asphyxiation from blast-furnace gas, by F. H. Willcox. 1916. 69 pp., 8 pls., 11 figs.

Technical Paper 165. Quarry accidents in the United States during the calendar year 1915, compiled by A. H. Fay. 1907. 77 pp., 1 pl.

Technical Paper 168. Metal-mine accidents in the United States during the calendar year 1915, compiled by A. H. Fay. 1917. 114 pp., 2 figs.

Note.—Only a limited supply of these publications is available for free distribution, and applicants are asked to cooperate in insuring an equitable distribution by selecting publications that are of especial interest. Requests for all papers can not be granted. Publications should be ordered by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

POTASH

Some years ago the United States was content to believe, and even freely acknowledged, that Germany held a world-monopoly in potash, and consequently that our grains and grasses and the greater part of our most nutritious foods were dependent upon the rejuvenation of our soils by this precious alkali, which came exclusively from the mines at Stassfurt. We were also taught to believe that the only possible rival of Stassfurt was the great salt deposit of Kalusz in the Carpathians. Recently the German technical staff has indulged in jubilant comment upon the crop-shortage in the United States for the season of 1916, attributing it directly to a scarcity of potash. As a matter of fact the diminished harvest last year, and the threatened deficiency in 1917, are the result of inclement weather-conditions in Western areas where fertilizers as yet have scarcely been applied to soils. Nevertheless there is an immediate scarcity of potash, and the price is correspondingly high, with a relatively inactive market. The increase in price from about $30 per ton for the chloride in normal times to $400, as now quoted, exerts a restraining influence on the agricultural demand as reflected through the manufacturers of fertilizers. The farmer is content to let the plants starve a little if necessary. It will be seen that, with such high prices for plant-foods, the farmers' investment in a growing crop is enormously increased, and the losses incident to unfavorable weather-conditions become increasingly great, introducing risks that might easily become ruinous. This situation deserves the serious consideration of the Government, and amid the host of other problems neither Congress nor the Departments of Agriculture and Commerce seem to have seriously grappled with the question.

An interesting fact, which should be made clear in order to create a correct public opinion upon this matter, is that we are not necessarily dependent on *Mittel Europa* for potash. Some of the cement-mills of America are making nearly as much money at this moment out of their by-product recovery of potash as they derive from the cement itself. Every cement works today is becoming a potash factory. The iron blast-furnaces are also preparing to enter the field. Not long ago Mr. R. J. Wysor of the Bethlehem Steel Company made an elaborate investigation into the possibilities of recovering larger quantities of potash than heretofore from the blast-furnace gases. He found that 20% of the original potash content remained in the gases after passing through the scrubber, and furthermore that the larger proportion of the total potash is dissolved and lost in the primary and secondary washers. An average furnace-charge at Bethlehem contains about 22 pounds of potash per ton of pig-iron produced, of which only 20% is carried off in the slag, leaving 80 % that may in part be recovered from the gases. Mr. Wysor states that the gases when passed through an experimental Cottrell electric dust-precipitator yielded practically all the potash in the collected precipitate. The saving effected by the same means at the cement factories ranges from 90 to 95% of the potash in the kiln-gases. It thus appears that in Pennsylvania alone, which produces normally ten million tons of pig-iron per annum, assuming a net recoverable 10 pounds of potash for each ton of pig-iron, 50,000 tons of potash might be made available yearly. Ohio would yield half as much on the same basis. In Alabama the outlook is still more remarkable. The so-called "gray ores" are exceptionally rich in potash, containing over 80 pounds of the alkali per ton of iron on the charge. The additions from coke-ash and flux bring up the total to nearly 100 pounds. Mr. Charles Catlett has estimated that a net recovery of 77 pounds of potash per ton of iron can be obtained in connection with the smelting of these ores. By the installation of the necessary equipment it is evident that the iron industry alone can supply over one-third of our normal demand for potash, obtainable at relatively insignificant cost as a by-product. The cement industry can do as much, so that our survival among the nations of the earth manifestly does not depend upon the favor of Germany. As a matter of fact we have not yet begun to realize upon these resources as we must. In 1916 the total output of by-product potash in the United States was only 8264 tons, with an additional 1550 tons derived from the treatment of kelp. The foregoing figures include molasses distillery waste, which contributed 1845 tons. It is not creditable to the energy and foresight of our people that we should have provided only 5% of our normal consumption of this vital necessary, when 60% at least is immediately available by the application of means that have been developed by Mr. Frederick G. Cottrell and his associates, and proved successful in operation.—*Mining Press.*

STELLITE

According to an account given in *Metaux et Alliages*, the hard non-ferrous alloy, stellite, invented three or four years ago in the United States by Elwood Haynes, marks a still greater advance in the art of cutting metals than established by the notable results obtained with the introduction of high-speed steel some years earlier. Where rate of production is a critical matter, as in the manufacture of ammunition, it has already made a remarkable record in competition with high-speed steel, a material which in point of capacity of production outclassed steels previously used. One of the advantages of stellite is that its hardness, which it maintains even at a red heat, is solely dependent upon the composition of the alloy, tungsten and chromium with additions of cobalt and molybdenum, and not upon the difficult and uncertain operations of heat treatment. Its fundamental advantage, however, lies in its ability to withstand a marked increase in speeds and feeds over those previously used with high-speed steels.

NOTES

The U. S. Army, quartermaster department, has given out a statement to the effect that they would need, in order to move 80,000 men, one field army, 6229 cars, made up into 366 trains with as many locomotives. These 6229 cars would consist of 2,115 passenger, 385 baggage, 1055 box, 1899 stock and 775 flat cars.

More than 10,000 chemists, metallurgists and mining engineers have been enrolled by the Bureau of Mines in its mobilization of technical men willing to help in the war. The list being tabulated for the use of the council of national defense and the army and navy, includes several thousand in the making of iron and steel.

The subway system of the Interborough Rapid Transit Company, New York, N. Y., has carried 2,958,200,205 passengers, about twice the population of the world, in ten years. Each year it carries more than a third of the total number of passengers carried on all the railroads of the United States. Only one passenger has been killed in a subway train accident in ten years.

In a certain laundry decidedly objectionable conditions prevailed on account of the air currents generated by rapidly rotating pulleys which sucked in dust with air from the outside, allowing it to settle upon the clean linen and in various spots where it was not wanted. The trouble was cured by clamping disks of sheet meal upon each side of the pulley arms, thus killing the centrifugal action.

During the three months ending March 31, 1917, there were 83,652,907 lbs. of bleached cotton fiber, including linters and hull fiber, consumed in the United States in the manufacture of guncotton and explosives of all kinds.

Zinc sulphate is not only a preservative of wood, but also of leather and other organic matter. A practical use of it is to saturate the soles of shoes and boots with a moderately strong solution of the salt. Thus treated the sole-leather resists wear to an extraordinary degree. Fabrics saturated in zinc-sulphate solution and then dried are resistant to fire; that is, though they will char on being heated, they will not transmit the flame by becoming ignited.

"When public money is honestly spent on a road every dollar becomes three dollars," says the Portland (Ore.) Journal. "First, there is the dollar in the road itself. Second, there remains in the community the dollar which has been paid out for labor and material. Third, there is the dollar of economic value added to the land adjacent to the road. This is a real value, not a speculative one. It is an increase in productive capacity."

A recent "heat-neutralizing mixture for treating burns" is formed as follows, according to U. S. Pat. 1,204,830: A lard-like mass is formed of 13 lb. lime, 3.5 gal. water, 7.5 lb. black mineral oil, 2.5 lb. red oil, 2.5 lb. soda ash and 1 lb. yellow ochre. This sounds all right, but the description then adds, "The mixture may also be used as a lubricant on axle journals or other machine parts." As this concoction seems to be a sort of *vade mecum*, we nominate it also for salad dressing, hair oil and hog-cholera cure.—*Eng. and Mining Journal.*

The Aircraft Manufacturers' Association desires to get into communication with all manufacturers of finished products and producers of raw materials entering into the construction of aircraft of all descriptions. It desires among other things samples of steel tubing, leather, aluminum, turnbuckles, aviators' wire, and catalogs of fittings, instruments and equipment of every sort. All communications, samples and data relating to the above materials should be addressed to the Aircraft Manufacturers' Association, 501 Fifth Avenue, New York.

Cordite has been discovered to possess the properties of a drug. It is said to have a sweetish taste and to produce temporary exhilaration with ultimate bad effect on the nervous system. Women munition workers in England, are said to have been detected chewing it.

The straw-hat trade of Luton and Dunstable, (England) and other places in the neighbourhood, depends upon the fact that the straw used for plaiting is grown on adjacent chalk land. The plant has great affinity for the silica in the chalk and flints, and uses it for coating the outside of the stalk with its beautiful glass-pipe covering. And it is due to this fact that America, although she grows such enormous quantities of wheat upon her alluvial lands--having no chalk land—has to send to England for straw, through which her people consume their iced drinks.

Work on the second Simplon Tunnel has been greatly impeded owing to war conditions. The work on the northern section was stopped in August, 1914, and was not recommenced until February, 1916, but work has been continued on the southern section with a reduced number of men. On July 31, a distance of 20,340 ft. of the northern section, and of 24,600 ft. of the southern had been tunnelled. At the present rate of progress it is calculated that the former section will be completed on December 31 next, and the latter on August 31, 1918.

Success in the Metallurgical use of powdered coal requires (1) that the coal have a high volatile content and a low percentage of ash; (2) that, after pulverizing, the moisture in the fuel shall not exceed 0.75 per cent.; (3) that the fuel shall be pulverized so that at least 95 per cent. will pass through a 100-mesh sieve and over 83 per cent. through a 200-mesh sieve; (4) that the delivery of the coal to the furnace shall be uniformly controlled regardless of the quantity required; (5) that the fuel be delivered to the furnace in a thoroughly atomized state and that combustion be completed while the coal is in suspension; (6) that in the application of the fuel to the furnace, the personal equation be eliminated as far as possible.—*C. J. Gadd, Journal of the Franklin Institute.*

A resourceful farmer has found a new way to use dynamite that saved a nearly matured crop of potatoes in a badly flooded field. Unusually heavy rains filled all the neighboring drains and ditches so there was no relief for the flooded field; and in this emergency the owner put down a number of holes eight to twelve feet deep with a post auger, and exploded a charge of dynamite in the bottom of each. This opened up passages into the sandy subsoil through which the surplus water drained rapidly, and the crop was saved, although many nearby crops were ruined by the excess of water standing in the fields.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

MAY 1

1,224,146. PUMP-UNLOADING DEVICE. Philip L. Crittenden, Edgewood, and Lawrence D. Saunders, Wilkinsburg, Pa.

1,224,180. APPARATUS FOR TREATING CERTAIN DISEASES OF THE HUMAN BODY. Simon Lake, Milford, Conn.

4. Therapeutic apparatus, comprising a substantially air-tight chamber, means associated with the chamber for creating a pressure therein above the normal atmospheric pressure surrounding the chamber, other means for reducing the pressure within the chamber below the normal surrounding atmospheric pressure, valves for maintaining a predetermined pressure within the chamber, a relief valve, and means for intermittenly operating the relief valve at regular intervals.

1,224,218. MEANS FOR PRODUCING AIR-CURRENTS. Harold M. Scheibe, Cambridge, Mass.

1,224,221. AUTOMATIC ATMOSPHERE VALVE. Harry Schwanebeck, Baltimore, Md.

1,224,238. BRAKE AND SAFETY CAR CONTROL. Walter V. Turner, Wilkinsburg, Pa.

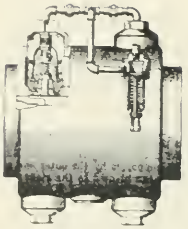
1,224,272. UNLOADER FOR AIR-COMPRESSORS. William H. Callan and George J. MacFadden, Franklin, Pa.

1,224,381. PUMP AND COMPRESSOR. Herbert Alfred Humphrey, London, and William Joseph Rusdell, Dudley, Worcester, England.

1,224,407. COMBINATION JOLT - RAMMING AND ROCK-OVER MACHINE. William C. Norcross, Terre Haute, Ind.

1,224,481-2. VACUUM CLEANING AND FORCE-DRAFT SYSTEM. Frank J. Matchette and Richard Raddatz, Milwaukee, Wis.

1,224,545. MEANS FOR DETERMINING GROUND SPEED. Lodewyk J. R. Holst, Philadelphia, Pa.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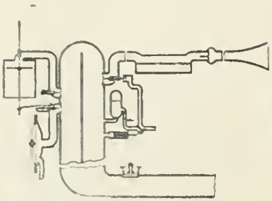
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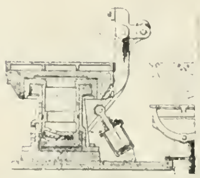
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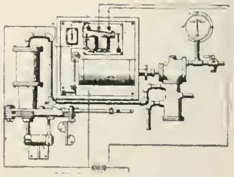
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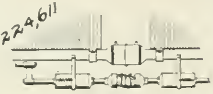
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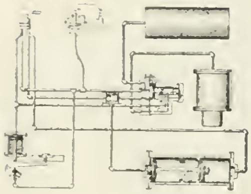
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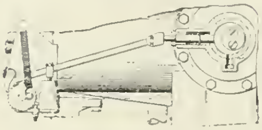
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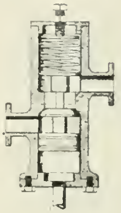
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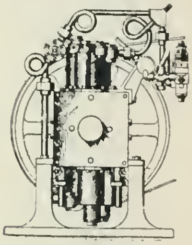

1,224,661

Pneumatic Patents May 1

1. Apparatus for determining the ground speed of air craft comprising in combination means, adjustable for different air craft elevations, for determining the beginning and end of the time interval required for an air craft to travel a predetermined distance over the earth's surface, and a timing mechanism graduated in units of ground speed for measuring the duration of said time interval.

1,224,611. AUTOMATIC COUPLING FOR AIR-PIPES. Harry Currier, Madison, Me.

1,224,661. MULTISTAGE COMPRESSOR. Nelson J. Parker, Lincoln, Ill.

1,224,723. TRAIN-STOPPING APPARATUS. Baltis Arthur Durham, Irvington, N. J.

MAY 8

1,224,914. GREASE-GUN. William T. Field and John A. Dumbolton, Lincoln, Nebr.

1,224,940. FLUID-PRESSURE-CONTROLLING APPARATUS FOR RAILWAY-VEHICLES. Lloyd V. Lewis, Edgewood borough, Pa.

1,225,211. APPARATUS FOR CONDITIONING AND DEHYDRATING FIBROUS AND OTHER BODIES. George Hillard Benjamin, New York, N. Y.

1,225,212. ART OF DRYING BODIES. George Hillard Benjamin, New York, N. Y.

1,225,269. BREATHING APPARATUS FOR USE IN NOXIOUS GASES. James W. Paul and Clarence Hall, Pittsburgh, Pa.

1,225,395. SPHYGMOMANOMETER. George F. Beachler, Cleveland, Ohio.

1,225,455. PNEUMATIC SHOE. Raffaele Marabini, New York, N. Y.

1,225,574. APPARATUS FOR CONDENSING GAS UNDER HIGH PRESSURE. Godfrey L. Cabot and James J. Cabot, Boston, Mass.

1,225,612. PERCUSSIVE TOOL. George James Gawley, Fleet, England.

1. An apparatus for utilizing atmospheric pressure for delivering impacts comprising a chamber having a closed end adapted to be placed against the article to be struck, the opposite end of said chamber being open to the atmosphere, a piston mounted in said chamber and adapted to be moved toward said closed end for delivering an impact thereto by atmospheric air entering said cylinder and means for moving said piston away from the closed end of the cylinder, whereby a vacuum will be created between the closed end of the cylinder and said piston.

1,225,684. AIR-MOISTENING DEVICE. Oliver I. Shaver, Park Rapids, Minn.

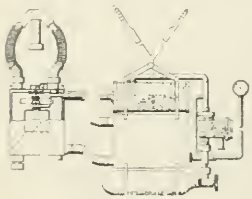
1,225,696. AIR-WASHING APPARATUS. Chas. H. Bicalky, Buffalo, N. Y.

1,225,709. PNEUMATIC ACTION FOR PNEUMATICALLY-OPERATED MUSICAL INSTRUMENTS. Adolph Peter Gustafson, Chicago, Ill.

1,225,724. VACUUM LIFTING-CUP. Carlton L. Smith, Saginaw, Mich.

MAY 15

1,225,805. AIR AND GAS COMPRESSOR. Augustus W. H. Griepe, New York, N. Y.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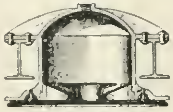
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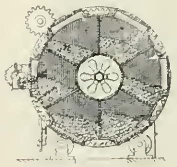
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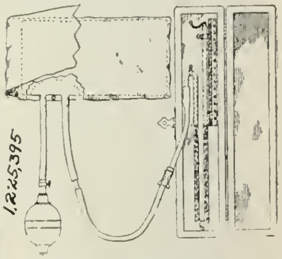
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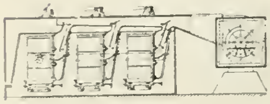
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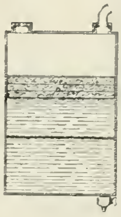
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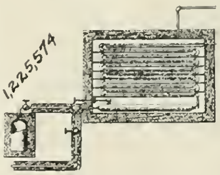
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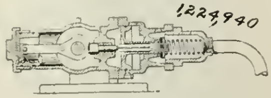

1,224,940

Pneumatic Patents May 8

1,225,817. COMPRESSOR. William H. Howe, Chicago, Ill.

1,225,898. ROCK-DRILL. Daniel Shaw Waugh, Denver, Colo.

1,225,902. PRESSURE-CONTROLLING MECHANISM FOR AUTOMATIC MUSICAL INSTRUMENTS. Edwin Welte, Freiburg, Germany.

1,225,940. ALARM DEVICE. Laurens P. Dixon, New York, N. Y.

1,226,011. DESICCATING APPARATUS. Chas. E. Rogers, Detroit, Mich.

1,226,131. BLOWER. Ira H. Spencer, West Hartford, Conn.

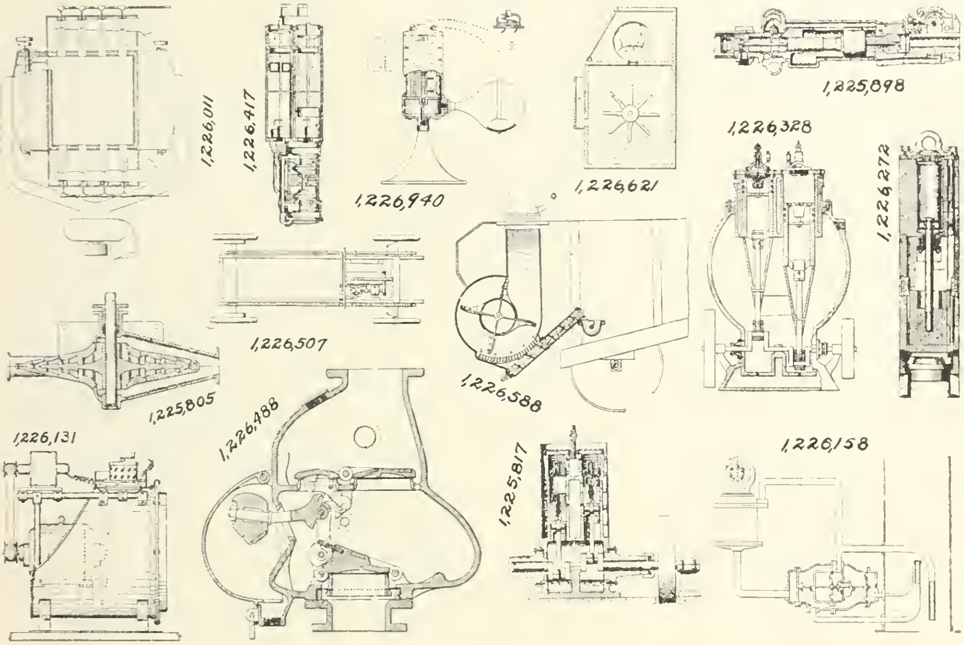
1,226,158. PROPORTIONAL GAS-METER. Thomas B. Wylie, Pittsburgh, Pa.

1,226,272. PILE-HAMMER. Thomas E. Sturtevant, Dover, N. J.

1,226,831. APPARATUS FOR TREATING COCOA AND OTHER PULVERULENT MATERIAL. John Walker, Boston, Mass.

1. An apparatus of the character specified comprising a centrifugal separator, a pipe of considerable extension and diameter coiled about said separator and connections therewith, and means for inducing a current of air with material therein to be treated to pass through said pipe and afterward develop a cyclonic action within said separator, said pipe and associated parts being adapted whereby as the air passes through said pipe the material therein may be subjected to attritive influence through contact with the wall of said pipe.

1,226,832. PNEUMATIC PITMAN-BALANCE FOR SWING-JAW ROCK AND ORE CRUSHERS. Fred M. Webber, Joplin, Mo.



Pneumatic Patents May 15

1,226,326. PNEUMATIC ACTION. Charles G. Gilberg, Rockford, Ill.

1,226,328. AIR-COMPRESSOR. Venable J. Guthrie, Cambria, Va.

1,226,408. DIE-CASTING MACHINE. Louis P. Tenca, Cleveland, Ohio.

1,226,417. FLUID-PRESSURE PUMP. Howard W. Truscott, Portland, Oreg.

1,226,488-9. DRY-PIPE VALVE. Powell Evans, Philadelphia, Pa.

1,226,507. TIRE-INFLATING APPARATUS. Learner E. Guess, Marion, Ky.

1,226,588. PNEUMATIC STRAW-STACKER. Victor N. Perry, Batavia, N. Y.

1,226,621. SAND-BLAST FOR SATIN-FINISHING METALS. Emil Gieland, Charlotte, N. C.

MAY 22

1,226,664. AIR-VALVE. Walter R. Hose, New Ulm, Minn.

1,226,673. PNEUMATIC CUSHIONING DEVICE. Peter W. Kane, Rochester, Wash.

1,226,702. VACUUM MASSAGE DEVICE. John G. Schlenter, Toledo, Ohio.

1,226,818. FLUID-PRESSURE SUCTION APPARATUS. John R. Schrader, New York, N. Y.

1,226,842. MILKING APPARATUS. Austin E. Anderson, East Randolph, N. Y.

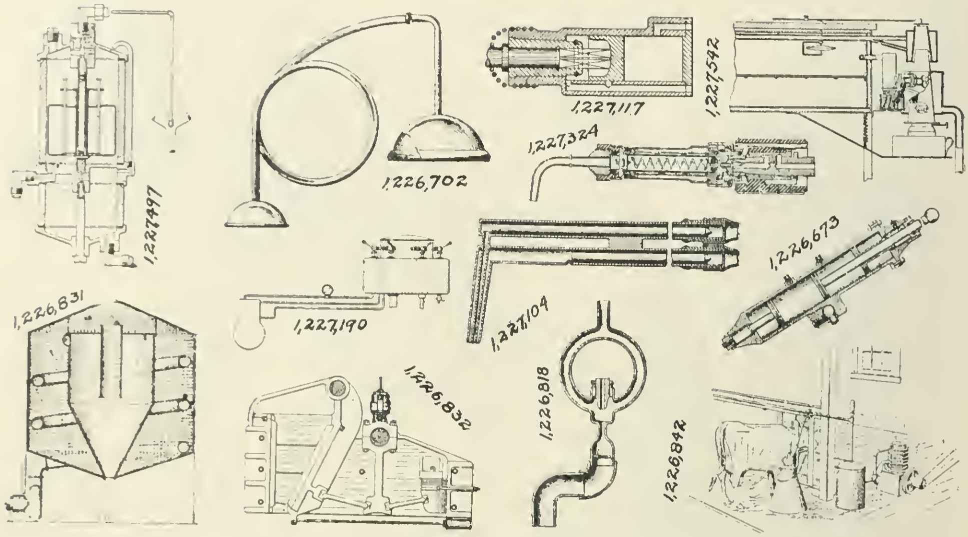
1,227,104. BLOWPIPE. James Aslin, Providence, R. I.

1,227,117. PNEUMATICALLY-OPERATED PERCUSSION-TOOL. Heinrich Christiansen, Pinneberg, Germany.

1,227,190. HUMIDIFYING APPARATUS. Frederick W. Parks, Fitchburg, Mass.

1. In a humidifying apparatus, the combination with a tank having a central water-receiving compartment and a separate closed compartment encircling the water-receiving compartment, said water-receiving compartment extending above the closed compartment, means to maintain air under pressure in the closed compartment, a self-contained compressed-air actuated humidifying head mounted on top of and connected to the closed compartment, a water inlet pipe extending from said head into the water-receiving compartment, and means to maintain the water level in the water-receiving compartment at a point slightly below that of the humidifying head.

1,227,324. AIR-HEATER. Percy Russell, Brooklyn, N. Y., and Frank J. Sepas, Philadelphia, and Edward B. Wilford, Merion borough, Pa.



Pneumatic Patents May 22

1,227,497. VACUUM SYSTEM. William Scott, Medford, Mass.

1. A vacuum system for maintaining a substantially uniform head on flowing fluids, having, in combination, an intake chamber, an inlet passage thereto, a discharge passage therefrom, means for vacuumizing the chamber, a vacuum passage leading into the chamber through which it is vacuumized, an air passage connected with the atmosphere and with the intake chamber normally closed, means for closing the vacuum passage when a predetermined amount of fluid has been brought into the chamber, and means actuated by the vacuumizing means upon the closing of the vacuum passage for opening the air passage to permit the chamber to be under atmospheric pressure.

1,227,510. PNEUMATIC PLAYER MECHANISM. Frank C. White, Meriden, Conn.

1,227,542. MOISTURE-SUPPLYING DEVICE FOR INCUBATORS. Dave O. Lager, Helena, Mont.

1. The combination with a lamp and a lamp chimney, of means for humidifying the heated air passing about the chimney, including a drum surrounding and carried by the chimney, said drum having a lower inlet port and an upper outlet port, said ports being disposed upon opposite sides of the drum, a pipe connected to the outlet port and extending radially from the drum, a water receptacle attached to the drum, said drum being further provided with a port in its wall adjacent the connection of the pipe at the outlet opening thereof, and a wick carrying member insertible in said port and carrying a wick for disposition within the water receptacle.

MAY 29

1,227,564. ROCK-DRILLING ENGINE. Gustaf Anderson, Stockholm, Sweden.

1,227,715. COMPRESSED-AIR ENGINE. Aaron B. Webb, Streator, Ill.

1,227,762. AIR-PUMP. Harley M. Dunlap, Battle Creek, Mich.

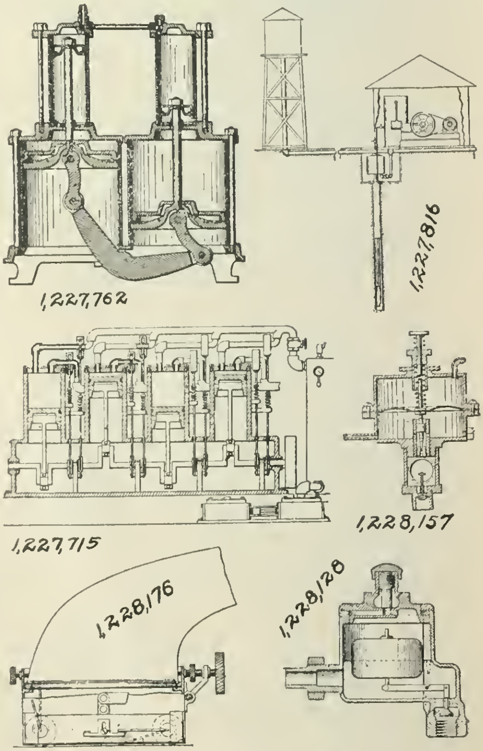
1,227,787. PNEUMATIC ACTION FOR PLAYER-PIANOS. Emory C. Hiscock, Chicago, Ill.

1,227,816. AIR-LIFT-PUMP BOOSTER. Frank S. Miller, deceased, Indianapolis, Ind., by Donold S. Morris, administrator *de bonis non*, Indianapolis, Ind.

1,228,128. VACUUM-TRAP. Andrew Olson, Chicago, Ill.

1,228,157. AIR-MOISTENER. William Wyand, Absecon, N. J.

1,228,176. VACUUM - CLEANER NOZZLE. Barry N. Bishop, Newark, N. J.



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COMPRESSED AIR MAGAZINE
EVERYTHING PNEUMATIC

Vol. xxii. AUGUST, 1917 No. 8.

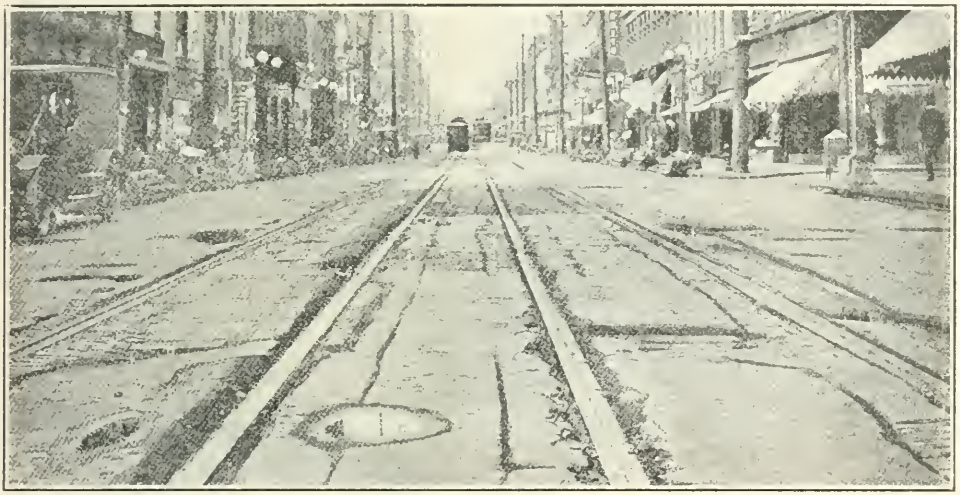

FIG. I. STREET IN ELMIRA BEFORE REPAVING

PNEUMATIC TOOLS ON STREET RAILWAY WORK

Mr. Frederic H. Hill, General Manager Elmira (N. Y.) Water, Light and Railroad Company, in a recent issue of Electric Railway Journal, gives us an interesting account of the reconstruction of double track and street paving in two of the principal business streets of Elmira, particularly emphasizing the saving of both time and labor by the employment of modern mechanical facilities. All the cars of the city operate over the tracks to be reconstructed and vehicle traffic on the streets also is heavy, so that it was of the utmost importance to push the work with all possible speed.

The general street condition is shown in Fig. 1, the photo having been taken apparently on Sunday when the street was temporarily clear. On Lake street the work consisted in relaying about 550 ft. of double track together with a cross-over and a single-track branch-off. The old construction was 8-in. plain girder rail laid on wood ties without ballast, and the paving consisted of sheet asphalt varying in thickness from 2 in. to 3 in. laid on old Belgian block paving without sub-base.

On Water Street the work consisted of relaying about 1400 ft. of double track, a cross-over, a single-track branch-off and a double track steam railroad crossing. The paving on Water Street was of the same general character as that just described for Lake Street, with the exception that for a short distance the asphalt was laid on a concrete base. The old construction here was 7-in. plain girder rail laid on wood ties without ballast.

Before commencing work tools and material were distributed and every arrangement was made to avoid delay, although the unforeseen things, disappointments in the supply of men

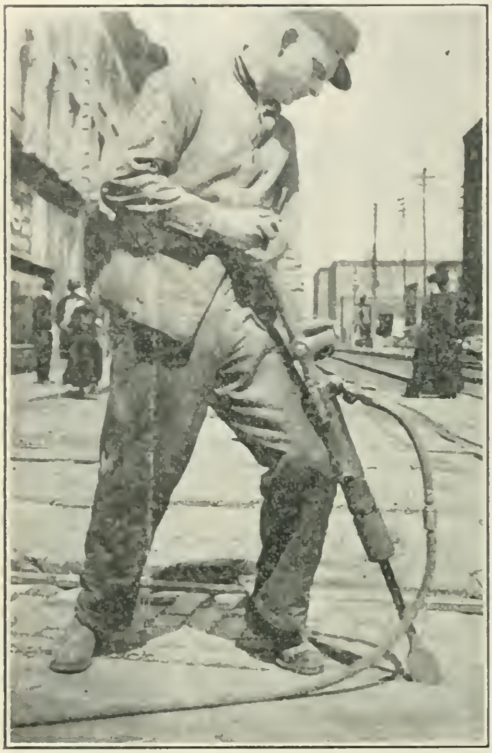

FIG. 2

and heavy rains, occurred as usual in the progress of the work.

ASPHALT CUT WITH PNEUMATIC TOOLS

The asphalt paving was first removed from between the rails and for a distance of 24 in. beyond the new line of the outer rails. For this purpose four pneumatic cutting tools were applied in a novel manner. These tools were the standard "Imperial" pneumatic tie tampers, made by the Ingersoll-Rand Company, but they were fitted with special cutting bars, made by changing the shape of the blunt bars used for tamping. This was done by forging the 3-in. by 5-8-in. face of the tamping bar down to an axe-like cutting edge. Another point of difference between the cutting and the tamping bar is that the former has a straight shank while the latter is slightly bent.

In beginning the operation of cutting the asphalt a notch or shallow groove was first cut along a chalk line drawn at the proper distance from the outer rails and parallel to them. In making this groove the operator slid the cutting edges along the pavement in front of him, guiding the tool with his knee, Fig. 2. It was found that the workman should be discouraged from guiding the tool with his foot, Fig. 3, as this method is slow and there is danger of the operator inflicting serious injuries upon himself. After cutting the groove the operator made a series of deeper cuts, leaving 8 in. to 10 in. between the cuts, the groove being depended upon to carry the break across these uncut sections. In making this deeper cut the tool was merely placed in the groove, held about vertical and rocked slightly back and forth, Fig. 4. After a few seconds the tool worked far enough into the pavement to enable it to be used as a pry bar, and an occasional prying action, Fig. 5, loosened considerable pavement.

TIME DATA ON ASPHALT CUTTING

An idea of the cutting speed of these tools can be gained from an observation made while the four tools were in operation making the outer break in the asphalt. In one hour and a half a 282 ft. cut was made, which is equivalent to 47 ft. per hour per tool

In removing the pavement between the rails

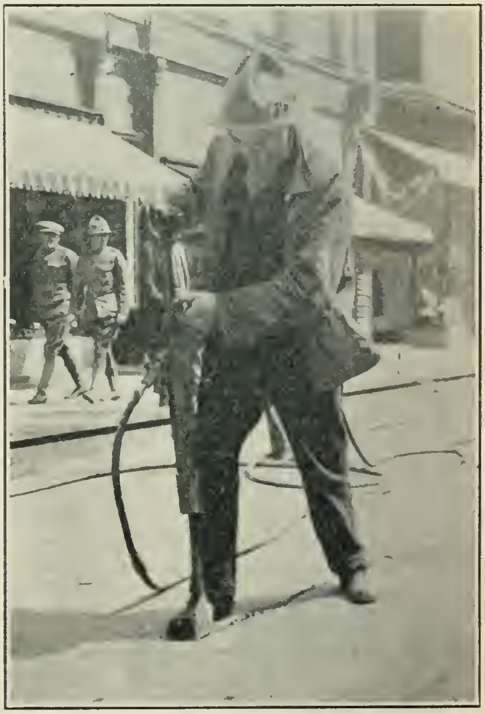

FIG. 3

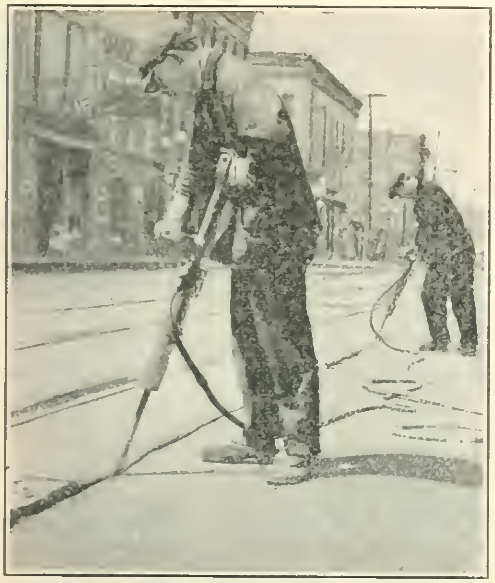

FIG. 4

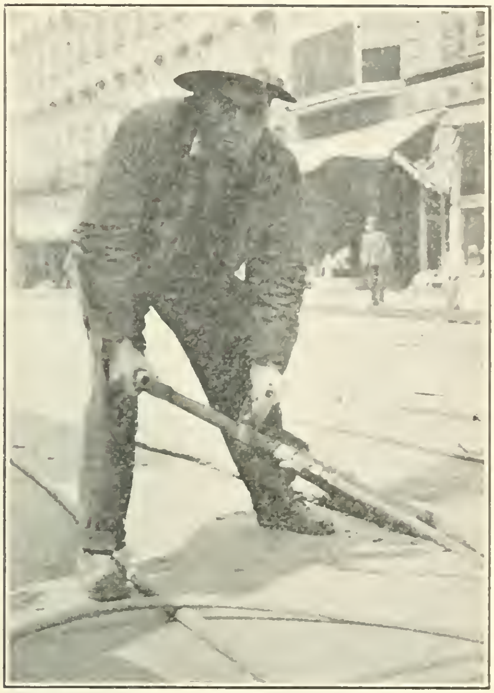

FIG. 5

advantage was taken of favorable locations for the cutting, such as along cracks and through thin spots. Good progress was also made by working the tools in pairs. The men faced each other and started the tools down inside of the rails and then pried up simultaneously, thus loosening the pavement from rail to rail. Subsequently the strips were broken into large chunks. Of course the progress in this varied greatly according to the condition of the pavement, interruptions and the like, but it is safe to say that in a shift of ten hours the average amount of pavement broken up was about 6,000 sq. ft. per hour per tool. With the aid of a pry bar the asphalt came up in

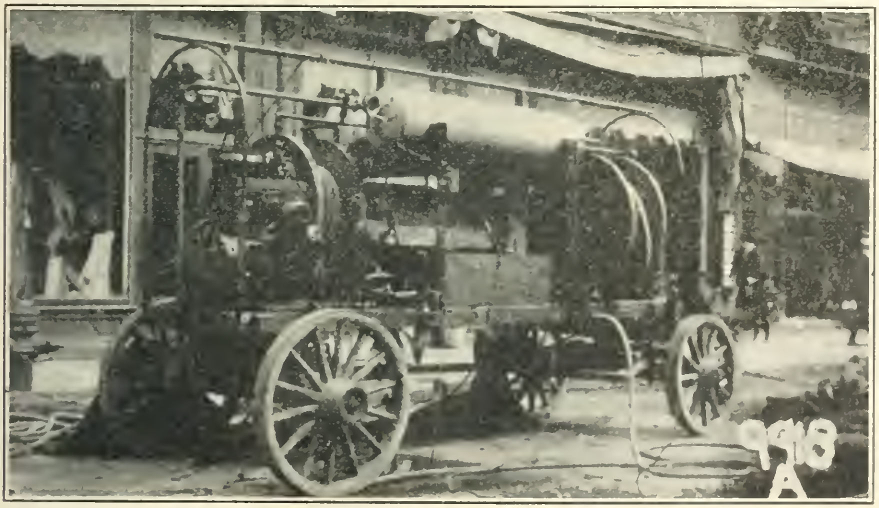

FIG. 6

long strips, which were broken up with mauls into sizes convenient for hand loading.

Where concrete occurred under the asphalt it was cut with the aid of tampers fitted with special picks. These picks were made by tapering and tamping a straight shank similar to that of the asphalt-cutting tools. The concrete was cut along the same line as the asphalt, by holding the tool vertical and rocking it slightly. By inserting the tool at intervals of about 6 in. the concrete was broken up readily. The use of the pneumatic concrete picks was relatively a greater saver of time and labor than for cutting the asphalt.

THE HOME-MADE COMPRESSOR

The normal air consumption of each pneumatic tool is rated at 16 cu. ft. of free air per minute at a pressure of 70 lb. per square inch. Air was supplied by a portable equipment mounted on a horse-drawn truck (Fig. 6). Two complete air compressor units were mounted on the truck. Each unit consisted of a direct-connected, electric-motor driven compressor of the type used on electric railway cars, an automatic governor, a receiving tank and 300 ft. of rubber hose. Each compressor had a piston displacement of 50 cu. ft. of air per minute. The hose was conveniently handled on two old wire reels, and a tool box located between the compressor provided room for tamping bars, tools, oil, etc.

It was considered advisable to adopt a double-unit compressor plant on account of its flexibility. Our large construction jobs are done mostly in the first three months of spring and summer, and after that it is a case of numerous small maintenance jobs. To handle this work it is planned to mount the compressors on work cars, so that two jobs can be carried on simultaneously. Also one unit can be used to furnish air in the shop and carhouse.

After the asphalt was broken up the rails were jacked up and removed, the nuts on the joint bolts being cut off with an oxy-acetylene blow-torch. As soon as the first pair of rails and their ties were removed a gang of shovellers began excavating for the new construction and as soon as they had cleared a sufficient space a steam shovel was put to work and carried the truck along the line. The steam shovel was followed by a 10 ton steam roller which compacted the subsoil in readiness for the ballast.

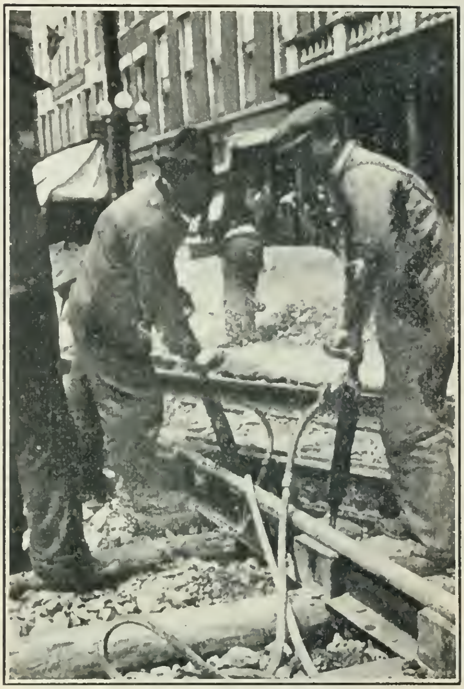

FIG. 7

After compacting the bed of the trench, oak ties 6 in. x 8 in. x 8 ft. were placed 2 ft. center to center. The new rails were 7-in. Lorain section No. 91-375. One rail of each track was roughly lined in, bolted and spiked. The other rail was then spiked to gage. The spiking was done by a crew of four men. Two, with bars, held the tie up against the rail and the other two drove the spikes with mauls.

BALLASTING WITH PNEUMATIC TAMPERS

After the spiking was completed the rails were jacked up to grade, leaving space of about 7 in. between the bottom of the ties and the sub-grade. Crushed stone ballast was then shovelled into place and tamped lightly under the ties with shovel and pick. The full length of the ties was tamped with the aid of the same pneumatic tools, which were employed for asphalt and concrete cutting. For this work standard tamping bars with 3-in. by ⅝-in. faces were used with the tools, and the men worked in pairs, one on each side of the tie, Fig. 7. By compacting the ballast from both sides simultaneously none of the force of the blows was spent in shifting the ballast from side to side. Observations made on one section showed that four machines tamped 340 ties in twenty-six consecutive hours. The average time required for two men with the pneumatic tampers to complete the tamping operation of a single tie was from six to seven minutes.

In tamping we operated with a gang of five men. The fifth man sounded the ties and watched the grade to see that the work was properly done. He also gave the necessary attention to the compressor plant and tools. Our observations indicate that this five-man gang will do as much work as twenty-four men with picks, and the tamping is better done.

While the ties were being tamped the rails were bonded with a Lincoln bonding machine. Coover track braces placed at intervals of about 20 ft. were bolted and then welded to the rail; the welding insured the security of the brace and also improved the cross bonding. Welds were made, using a carbon pencil and scrap copper. Copper wire cross bonds were placed at the end of each section and around all special work.

SELF-PROPELLED CONCRETE MIXER

After tamping, the ballast extended halfway up the ties and the roadbed was ready for concreting. Before beginning to place the concrete Nelsonville filler blocks were first laid against the web of the rails on the inside of the track, and then the concrete was placed to cover the ties a depth of 2 in. Crushed stone and cement were distributed along the street on one side and sand on the other in estimated quantities. A self-propelled ½-yd. Ransome concrete mixer (Fig. 8) was used on the same side of the street as the stone. A gang of about thirty men were able to concrete 50 lineal feet, or about 1,000 sq. ft., per hour.

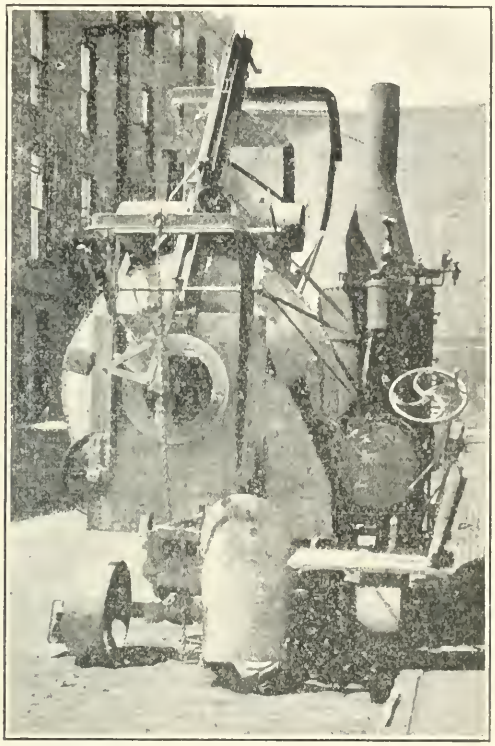

FIG. 8

The outside of the T-rails was plastered with cement mortar, and then over the concrete a 1-in. sand cushion was placed. This was rolled with a hand roller and graded, giving a final thickness of about 1 in. The bricks were then laid next to the filler on the inside of the track. A 5-ton tandem roller was used for final rolling. The spaces between the new pavement and the old asphalt were filled with grout, and pitch was used to fill cracks between bricks. A little sand was sprinkled on the brick and the street was then opened to traffic. A cross-section of the complete construction is shown in Fig. 9.

RESULTS OF USE OF PROPER EQUIPMENT

The advantages of suitable equipment and

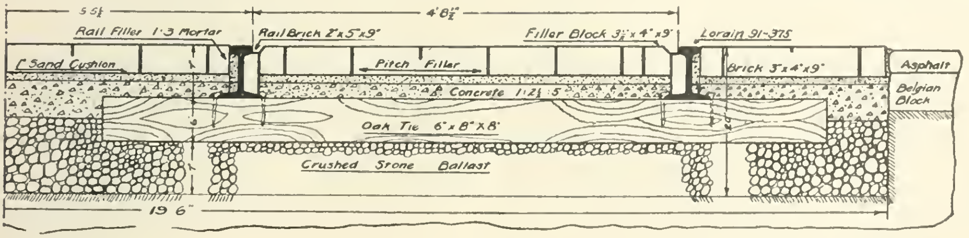

FIG. 9

organization are shown clearly by the progress made: on Lake Street (550 ft. of double track, one cross-over and one single track branch-off) where fourteen days were required, and on Water Street (1400 ft. of double track, one cross-over, one single-track branch-off and one double-track crossing) where nineteen days were required. The work was carried out by the company's own organization, augmented by laborers and gang bosses temporarily employed for the job. F. G. Maloney, superintendent of the railroad department, had direct charge of the work.

AVIATION DEVELOPMENTS.

In the course of a lecture delivered by Brigadier-General Brancker to the members of the Aeronautical Society of Great Britain some time ago, the author said the way in which war had forced a higher standard on us was remarkable. Only two and a half years ago, a pilot who flew across country at 3,500 ft. and landed without breaking anything was considered to be quite useful. Now the expert pilot has to be prepared to fly at the greatest height his machine will reach, which is sometimes about 17,000 ft., has to dive and loop and side-slip to enable him to be an efficient fighter, and has to have considerable experience in photography from the air, in the observation of artillery fire, and the transmission of the results by wireless to the ground, and in the use of the machine gun. In addition, he must be an expert bomb dropper, which needs considerable practice and experience, and finally in bombing raids, long reconnaissances, and in fighting patrols, it is necessary for aeroplanes to fly in a fixed formation in numbers from two up to twenty, an operation demanding a great deal of skill and experience in the pilot.

TEST FOR CARBON MONOXIDE

Perhaps the best chemical test for carbon monoxide, in that other gases do not interfere and that very simple apparatus is required, is by the use of blood diluted with water to a buff-yellow tint. This test, in the author's experience, is capable of distinctly showing as little as 0.03 per cent. of carbon monoxide in the atmosphere. The method of procedure is as follows:

One or two drops of blood from the finger are diluted with water until equal portions of the solutions placed in 100 c.c test tubes have a buff-yellow color; one of the tubes is taken into the mine, and at the place where the air is to be tested about 50 c.c. of the blood solution is poured out, the mine air taking its place. The tube is then corked, taken to the surface, and gently shaken for 10 min. If the air contains carbon monoxide, the pink color caused by the presence of carbon monoxide hemoglobin is detected by comparing the solution with the normal blood solution in the other tube.—*U. S. Bureau of Mines Tech. Paper* 11.

GRAPHIC SOLUTION OF COMPRESSED AIR TRANSMISSION PROBLEMS

BY C. W. CRISPELL*

The nomogram on the opposite page gives a graphic solution of D'Arcy's formula for the transmission of compressed air in pipes. This formula is:

$$D = c\sqrt{\frac{d^5\,(p_1 - p_2)}{w_1 l}} = \frac{c\sqrt{d^5}}{\sqrt{l}}\sqrt{\frac{(p_1 - p_2)}{w_1}}$$

where:

D = the volume of compressed air in cubic feet per minute discharged at the final pressure.

c = a coefficient varying with the diameter of the pipe, as determined by experiment.

d = actual diameter of pipe in inches.

l = length of pipe in feet.

p_1 = initial gage pressure in pounds per square inch.

p_2 = final gage pressure in pounds per square inch.

w_1 = the density of the air, or its weight per cubic foot, at initial pressure.

The nomogram allows the solution of this equation without reference to tables for values of $c\sqrt{d^5}$ and $\sqrt{\frac{p_1 - p_2}{w_1}}$ which are ordinarily used for this purpose.

The following cases may arise in connection with the transmission of compressed air through pipes:

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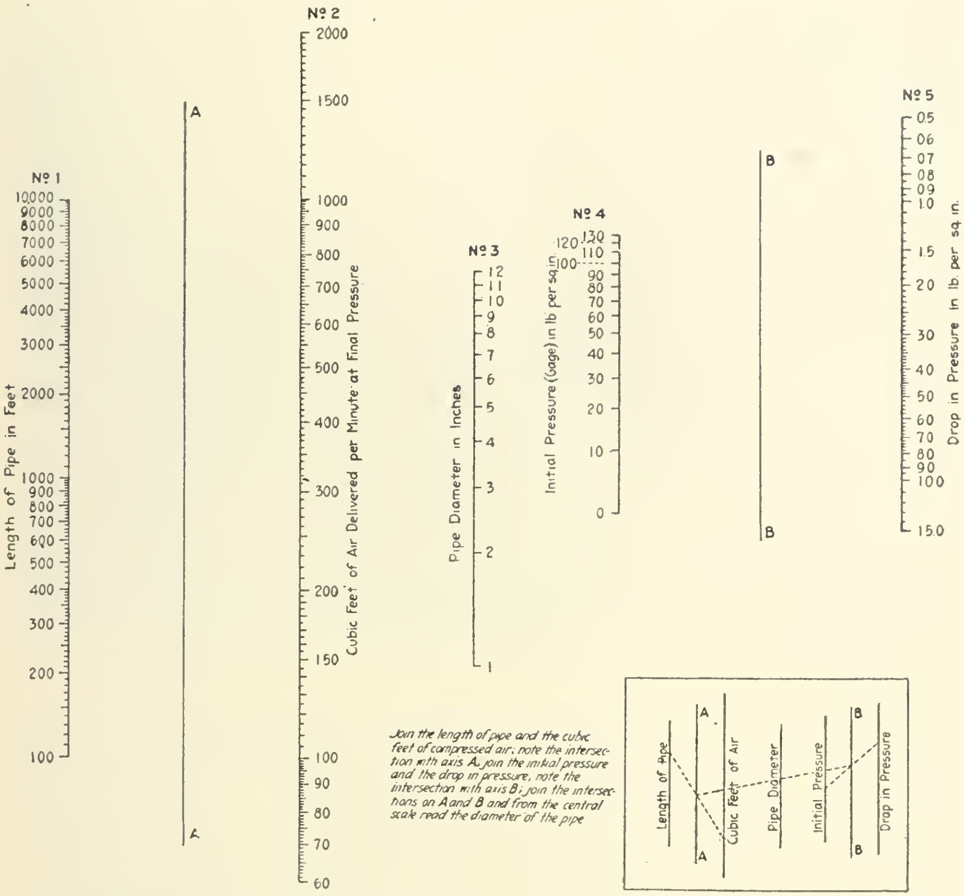
*Transactions American Institute of Mining Engineers.



Join the length of pipe and the cubic feet of compressed air; note the intersection with axis A, join the initial pressure and the drop in pressure, note the intersection with axis B; join the intersections on A and B and from the central scale read the diameter of the pipe

1. Given the volume of compressed air, the length of pipe, the initial pressure, and the maximum allowable drop in pressure; required, the diameter of the pipe.

2. Given the length of pipe, the diameter of pipe, the initial pressure, and the maximum allowable drop in pressure; required, the volume of compressed air which the pipe will carry.

3. Given the diameter of the pipe, the volume of compressed air, the initial pressure, and the maximum allowable drop in pressure; required, the maximum length of pipe of the given diameter which can be used under these conditions.

4. Given the diameter of the pipe, the volume of compressed air, the length of pipe, and the maximum allowable drop in pressure; required, the pressure at which the air must enter the pipe.

5. Given the diameter of the pipe, the volume of compressed air, the length of pipe, and the initial pressure; required, the drop in pressure.

The graphic solution of each of these problems may be obtained as follows:

Case 1.—With a straight edge, join the length of pipe and the cubic feet of compressed air (not free air); note the intersection on axis *A*; join the initial pressure with the drop in pressure; note the intersection on axis *B*. A line joining the two points on *A* and B will intersect scale number 3 at the required pipe diameter.

Case 2.—With a straight edge, join the initial pressure with the drop in pressure, note the intersection on axis *B;* join the intersection on *B* with the diameter of the pipe; note the intersection on axis *A*. A line joining this point on *A* with the length of pipe will intersect scale number 2 at the required volume of compressed air.

Case 3.—With a straight edge, join the initial pressure with the drop in pressure; note the intersection on axis *B;* join the intersection on *B* with the diameter of the pipe; note the intersection on axis *A*. A line joining this point on *A* with the given cubic feet of compressed air intersects scale number 1 at the required maximum length of pipe.

Case 4.—With a straight edge, join the length of pipe with the volume of compressed air; note the intersection on axis *A*; join the intersection on *A* with the diameter of the pipe; note the intersection on axis *B*. A line joining this point on *B* with the allowable drop in pressure intersects scale number 4 at the required initial pressure at the entrance of the pipe.

Case 5.—With a straight edge, join the length of pipe with the volume of compressed air; note the intersection on axis *A;* join the intersection on *A* with the diameter of the pipe; note the intersection on axis *B*. A line joining this point on *B* with the given initial pressure will intersect scale number 5 at the required drop in pressure.

THE FATAL GAS EXPLOSION IN CLEVELAND WATERWORKS TUNNEL*

The city of Cleveland is building a 10 foot cylindrical tunnel connecting crib No. 4, a mile out in the lake with crib No. 5 four miles further out, working from both ends. On July 24, 1916, a gas explosion at crib No. 5 end caused the death of nine men, and an hour or so later ten more men lost their lives trying to get into the working place.

Nearly every paragraph of the various State mine laws has been written as the result of such a catastrophe as that here spoken of. The mining men of this country and the Federal Bureau of Mines are trying to benefit by each explosion and each accident, putting the details on record so that similar accidents may be prevented.

Fig. 1 is an interior view of the tunnel. The 6 in. pipe, mid-height, on the left carries the fresh air from the compressors on the crib down to the working force. The view was taken before the explosion, as after that all the electric lights and the wiring were removed.

Fig. 2 shows the shield, which is 12 feet 2 inches in diameter and 14 feet long, the cutting edge being shoved into the mud by hydraulic jacks. The men were working at the front of the cutting edge digging out the mud, cutting it down with knives, when a large quantity of mud was blown up in front of the cutting edges by a gas blower. When the foreman saw this he was nearly ready to shove the shield. He thought that if he shoved the large shield ahead 2 or 3 feet it would cut off the blower and prevent the gas from coming up in the tunnel. The shield closed off the gas temporarily, but it accumulated enough pressure down under the shield so that eventually it forced its way out at the tail end and again passed into the tunnel. As it was a hydrocarbon gas lighter than air, of course it rose to the roof of the tunnel.

An important mechanical device in connection with the shield is the erector for placing the successive segments of the tunnel lining in position. The gas from under the shield accumulated at the roof of the tunnel and the operator on this erector became sick and had trouble in breathing, because the pressure of the gas decreased the oxygen percentage of the atmosphere he was breathing. He came down and the foreman sent another man to take his place. The second man was overcome, but not entirely—just had trouble in breathing, and became sick. The foreman himself tried the task and also had trouble in breathing, so that he decided to leave the tunnel, and did so. The men working at the face, having trouble in breathing decided to go out. The tunnel at this time was 1,400 feet from the lock to the face. In walking back toward the lock they had to ascend to a point where the tunnel was 9 feet higher than at the face. In passing this high point the whole crew had serious trouble in breathing.

This condition was reported and the general superintendent came out next day with the crib superintendent and went down to investigate, taking some pipe fitters with them. As

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*Abstract of portion of address before Cleveland Engineering Society, January 16, 1917, by W. J. German, Engineer Federal Bureau of Mines, Pittsburgh.

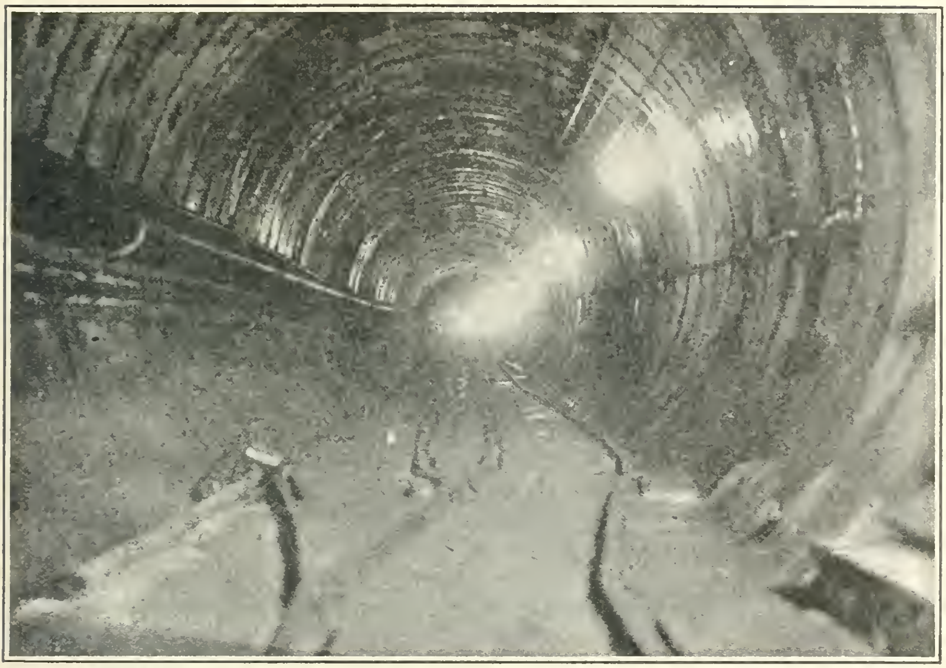


FIG. 1. INTERIOR OF TUNNEL

they approached the summit they had trouble in breathing because the gas had reduced the percentage of oxygen. They drilled ¾ inch holes in the 6 inch air line at 200 foot intervals and at the summit the hole was piped leading the air to the roof of the tunnel. Passing this the men had no trouble in reaching the face. In the erector operator's box there was still difficulty in breathing. A 45 degree elbow was placed on the end of the 6 inch air line conducting the air right up into the electric motors which drove the erector.

The percentage of gas there at the time may be judged from samples taken at that point afterwards under nearly the same conditions I should judge that the gas at that time, before they put the elbow on, was far above the explosive point, so that although these men were using the electrical machinery, and undoubtedly producing sparks, no explosion occurred. They put on the 45-degree elbow and turned the fresh air up to the roof of the tunnel, stopping it from going to the face and bringing the high proportion of gas in the mixture down somewhere near the highest explosive point around 8½ or 9. After this was done, they shut down the tunnel for a day.

The general superintendent and the crib superintendent went down again the next day and experienced no trouble in breathing. They walked over the summit, went to the face, and got up into the operator's box, but they had no trouble. They came out and decided to let the shift go to work that night. On the evening of July 24 ten men went down the tunnel to start to dig out and take up the work

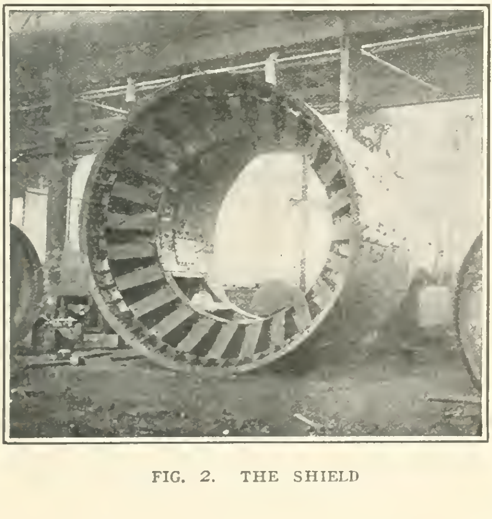


FIG. 2. THE SHIELD

that was left by the crew that was down on the night of July 22.

SOMETHING WRONG

They had been down at the face one hour when the engineer up on the crib noticed an increase in the pressure shown by the gage from 22 pounds to about 35 pounds. Seeing that there was something wrong he called the crib superintendent, who looked at the gage and then tried to talk to the men down at the face of the tunnel, but no one answered. He went down the shaft and coming to the lock he looked through the bull's-eye and saw the lock tender cleaning the debris away from the inside door in order to close it and come out. He watched him for a minute or so, then came to the top again and tried to telephone to the men at the face to send men back to help get the door closed, but he could get no answer He came back down and by this time the locktender had come out.

The locktender said: "I don't know what has happened, only that the flooring is blown up and the ties are thrown all around." The superintendent, accompanied by the locktender, went in about a hundred feet, expecting to see the regular lights in the tunnel, but they were all torn down, although the current was still on the tangled wires in the debris.

The superintendent then came out to get some flashlights. He was not affected at all by the after-damp, as seemingly it had not as yet diffused back that far. He procured some flashlights and six men to go in with him. When he got inside the lock, that is, into the tunnel, he left the locktender and one other man to take care of the lock and advanced with the other four men. After getting in about a hundred feet and looking around to see that they were following, they were all on the floor stretched out. He turned to help the man next to him and when he was in the act of getting him on his shoulder he himself was overcome and lost all control of his limbs, though still conscious but unable to call for help. His flashlight was turned toward the lock and the two men there advanced quickly and brought him back to the lock, by that time having hardly strength enough to shut the inside door and operate the valves to get out. Leaving the four men still on the tunnel floor unconscious, they went to the top and when they were in the fresh air they became unconscious and lay there for two hours before any help came. There being no telephone or other communication with the shore the crib employes sent up rockets, blew the whistle and finally attracted somebody's attention, and life-saving crews took the unconscious men ashore.

By this time the general superintendent had received word and he came out on another boat with several men, but did not see the superintendent going ashore. When the general superintendent arrived at the Crib he organized a crew of seven men besides himself and went down into the tunnel without making any inquiries. They advanced inside of the lock about 200 feet to the section where the 3-4 inch holes were bored in the 6-inch pipe. The superintendent was in the lead of the party and the other seven men were strung from the lock in. He and all his crew fell unconscious.

THE LOCKING OF THE LOCK

The lock was "in," and no one could open it from the outside because the pressure was against the outside door and unless someone was left inside to operate the valves, no one else could get in the tunnel while the pressure was on, so they lay there for about five hours before anything else was done.

At about this time the waterworks officials arrived at the crib and heard that the men had gone down and had not come back. They refused to let anyone else go down until a conference had been held. In the meantime. city firemen had arrived on the scene with some breathing apparatus and after the conference they decided to let some of the workmen go down to the air lock with the breathing apparatus on. The workmen looked in and could see some of the men in the lock lying as though dead. They came back and reported. After another conference, decision was reached to take the air pressure off the tunnel in order to get the bodies out. The only way this could be done was to break a glass bull's-eye in the lock door. The bull's-eye was 4 inches in diameter and 1 inch thick.

Breaking the bull's eye and taking the pressure off the tunnel took about four hours. After the pressure was off, the general superintendent and the man next to him revived without any assistance because they had fallen near a 3-4 inch hole in the air pipe and had been getting some fresh air. They walked out and opened the lock door and came up. When these men came in contact with the fresh air is seemed to have some overpowering effect on them and they could not tell what had happened in the tunnel. A crew of men, some wtih apparatus and some without, went down and brought out the bodies of the rescue party, totalling ten; all were dead.

BUREAU OF MINES TAKES HOLD

About this time the Bureau of Mines rescue party, of which I was a member, arrived in charge of D. J. Parker and L. M. Jones, mining engineer. (The latter, I regret to say, has since lost his life in mine rescue work at Barracksville, W. Va.). They were making preparations to go down when they were informed that men had been in to the lock and had brought out the bodies. They then decided to make an inspection. The regular precautions that are taken at a mine were observed; that is they carried safety lamps to test for methane, and they took a canary to warn them of the presence of carbon monoxide. Their first safety lamp test at the top of the shaft showed about 5 per cent. of methane coming out of the tunnel.

The electric current was still in the wires in the tunnel and there was a light in the lock. The wires in the tunnel beyond the lock were twisted up in the debris and there was an explosive mixture of gas. This was an extremely dangerous situation, so they cut the current off on the crib before advancing into the toe of the mud. This point is 300 feet from the original face, or from the face of the tunnel at the time of the accident. When the men arrived at this point they found that the tunnel was filled with mud. The rail was marked and it was found that the mud was filling the tunnel at the rate of 4 feet per hour. They were satisfied that the men who had been caught at the face were dead, judging from the evidences of violence in the tunnel. It was decided to come out and close the lock and get the air pressure back on the tunnel. It took several hours to bring the pressure up to a point that would stop the mud from creeping in. As it was getting late the tunnel was closed for the night and the Bureau men came ashore.

The next morning H. M. Wolfin, then mine safety engineer of the Bureau, accompanied by three other Bureau men, made an inspection and found that the gas was still coming out through the top of the crib. In order to start operations it was decided that a blowing fan had better be put on the crib and an 8 inch galvanized iron pipe put down the shaft to blow fresh air into the lock. A blower man from the city came out and started to put down the pipe. It was a very dangerous job for a man who was not used to working in gas. He installed the pipe from the crib to the lock and an engine and fan was erected on the crib and put in operation about midnight. The next morning the air in the shaft was nearly free from gas and the men could detect only about 3 per cent. of gas down at the lock, but it was still blowing out through the lock door. When they went inside the lock the gas at the roof was far above the explosive point.

The crew advanced into the tunnel 1,200 feet and in looking around they found that the 6-inch air line that went to the face was broken at the toe of the mud. The break was due to the force of the explosion. The chief electrician was down with the crew at this time and he noticed an outward pressure. The pressure on the tunnel was 30 pounds, but still there was an outward pressure from the 6-inch line. The Bureau men took a sample of the gaseous mixture that was coming from the pipe and it showed 60 per cent. methane. It was decided that the gas in the tunnel was coming from this break. They contemplated using one of the 2-inch pipes, shown in Fig. 1, that was used for a waterline before the explosion, and the necessary connection was made to join the 2-inch line to the 6-inch line. They disconnected the 2-inch line from the water pump on the crib and extended it out through the roof of the crib and let it discharge to the atmosphere. The pressure was greater than 30 pounds and the gas roared out on top of the crib. Samples were taken from this pipe every day for several weeks and none showed less than 30 per cent. methane. You can see the situation. The gas blower and the shield were in the face and 300 feet of mud behind it. The gas came from beneath the shield. The mud that filled the tunnel did not come from the face, but it came through the holes in the roof. The block lining of the tunnel was badly damaged and ten holes were blown in the roof. Twenty of the blocks that were blown out have never been accounted for. They were probably blown up into the mud at the bottom of the lake. The men in charge placed timber across these holes and put in brick and built arches.

You can understand the circuit of gas. It was feeding into the 8-foot space at the front end of the mud and passing into the 6-inch line and out into that part of the tunnel extending from the toe of the mud to the lock. The mud acted as a seal and the gas escaped only through the pipe to the surface so that 22 hours afterwards the tunnel was free from gas.

The tunnel officials then went ahead to clean out the mud. Of course, the track had to be relaid, as it had been blown out. New flooring was put down and the work of clearing out the mud was started. The holes in the roof were timbered first. The mud was cleared 8 feet in advance of a hole which was then bricked up, because the mud was very soft and would force its way into the tunnel. Between two of the timbers there was a half inch space through which, in spite of the 30 pound pressure, the mud came like a sheet of steel in the rolling mill and coiled up on the floor. The men were not allowed to advance too far until the holes were bricked up. Advance was made in this way until the men arrived at a point 100 feet from the toe of the mud. There, two bodies were found under blocks. The legs had been blown off one man and each man's neck was broken and each had been burned severely. After the work of advancing had proceeded about three or four weeks more, as near as I remember, the rest of the bodies were recovered at the face. They were in an awful condition. All had been burned and had suffered broken necks and backs.

After all the mud had been cleared out, the seal on the gas was gone, so that the gas no longer passed through the 2-inch pipe, but came into the tunnel. The day after all the bodies had been recovered, the tunnel was filled with gas and the conditions were just as dangerous as the day after the explosion. However, the bodies were out, and the Bureau officials were satisfied to take a little time to devise some scheme for removing the gas.

The slab forging for the crankshaft of a 125-horsepower airplane engine weights 605 lb. The finished shaft weighs 46 lb. The forging, of chrome-vanadium steel, costs over $200.00.—*The Gas Engine.*

A PNEUMATIC CONCENTRATOR AND AMALGAMATOR

BY FRANK A. STANLEY

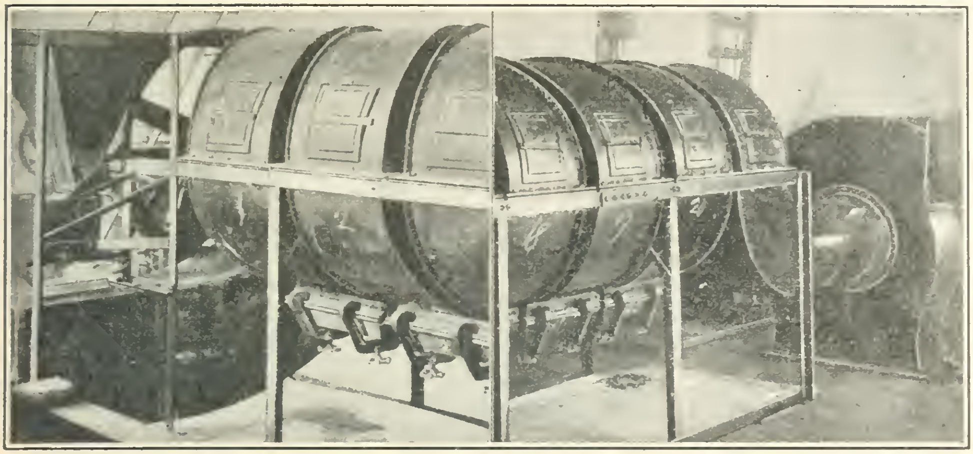
The illustrations show a pneumatic concentrator and amalgamator consisting of a vertical conduit in which a circular air current is produced by an exhaust fan at the conduit terminal, the speed of the air current being varied as desired to suit the fineness of the gold to be amalgamated.

The material, which is finely pulverized in order to entirely free the gold, is fed at the intake in predetermined quantity, at a rate so that the air current will carry it in suspension in the form of a cloud throughout the whole length of the conduit. Mercury-charged eddying chambers are attached outside the path of the circular air current along the bottom of the conduit opposite each complete circle; and a set of revolving agitators are operated in each of these chambers to assist amalgamation.

The centrifugal force imparted to the finely pulverized material by the circular air current causes the heaviest material to crowd closest to the outer wall of the conduit and to leave its helical path on reaching the openings to the eddying chambers—the heaviest gold first and the finer gold later on as it acquires accelerated centrifugal force and the full speed of the circular air current.

The design of the apparatus will be understood by reference to the illustrations, the first showing the feeding and the last the discharging arrangements. The exhaust fan is connected with the discharge end, which produces the circular air current for carrying the material through the apparatus. These views show the series of mercury-charged vessels along the bottom of the amalgamator in which the gold is amalgamated.

The line drawing shows important features of construction. To the lower part of lower sections are attached the amalgam chambers. Each section is so formed that two of them complete one turn, or winding. In the machine illustrated there are 20 windings and a total length of air passage of 210 ft. The cross-section of the conduit is rectangular in form, and the sections are constructed of sheet metal with flange and bolt connections along the horizontal center line. This enables a conduit of any desired length to be built up or readily taken apart.



FEED END

DISCHARGE END

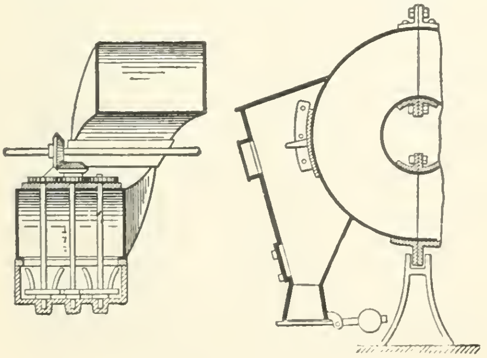
The intake is in reality a horizontal extension of the first section of the conduit, and here the air is taken in to be drawn through the entire conduit with a speed dependent upon the nature of the material. The ground ore is introduced through a branch pipe over the mouth of which is placed a sieve, while directly above this sieve there is a hopper with a loose bottom, which is regulated to control the quantity to be fed. By means of the sieve the material is agitated and delivered into the conduit in a finely divided condition. Motion is imparted to the hopper bottom in the sieve by means of a camshaft which agitates the sieve, which in turn actuates the hopper bottom.

The amalgam chambers extend across the entire width of the conduit, and perpendicular to each chamber there is a series of agitators calculated to facilitate amalgamation. These agitators are driven by spur-and-bevel gearing by a central shaft, an arrangement that simultaneously drives all the agiators in all the chambers. Each of the agitators is provided with projecting fingers which extend to the top of the amalgam chamber. The vessels may be removed, emptied and recharged with mercury.

It will be seen that there are few moving parts to break down or wear out. Instead of centrifugal force being imparted to the material, this force is created by the air current produced by the suction of the exhaust fan; so that the material, instead of traveling where it is pushed, is in reality drawn through by suction and follows the current. The particles of material are therefore free to change their relative positions in the current under the influence of centrifugal action.

With this air current produced by suction the barometric pressure is different at every point and increases gradually from center to circumference and is at all points lower than the external atmospheric pressure. These conditions greatly facilitate the separation of the gold by centrifugal force.

The material must be pulverized to a state of fineness so that the coarsest particle of gangue will not be heavier than the finest particle of gold to be separated. The pulverizing should be done by impact crushing, so that the gold, being malleable, will flatten, while the gangue will pulverize. A particle of gold and a particle of gangue each passing 150-mesh would be easily separated because the gold will



SKETCH OF DETAILS

be about eight times heavier than the gangue. In the same proportion any particle of gold up to eight times smaller than 150-mesh—that is, up to 1,200 to the inch—will be collected in the eddying chambers and amalgamated. The agitators in the eddying chambers are intended to agitate the concentrates in order to bring the gold into intimate contact with the mercury which is below the concentrates and entirely away from the path of the circular air current.

Gold recovery is practically uniform when once the machine is regulated for the particular material. If the gold is coarse, a 15 ton amalgamator may be speeded up to 20 tons per day, and if the gold is fine the speed may have to be reduced to 12 tons a day. If there is any gold left in the tailings, the speed of the machine should be reduced until the exact point is reached when all the gold is recovered.

Actual results obtained with this machine show from 95 to practically 100 per cent. of the gold can be recovered. The following test data are characteristic of numerous runs:

	First Run %	Second Run %
First five amalgam pans......	98.400	89.900
Second five amalgam pans....	.940	6.480
Third five amalgam pans.....	.005	2 210
Fourth five amalgam pans....	.004	1.200
	99.349	99.790

A pneumatic concentrator may be constructed on pratcically the same principle as the machine already described.

The concentrates are collected in side-compartments provided, from which they are discharged automatically through the channel by way of the counterbalanced gates, which in consequence of the suction are held closed until the weight of the accumulated concentrates overcomes the suction, when the gates open to discharge the material and then automatically close. By means of side openings counter-currents may be effected, and in this way the discharge of the concentrate can be regulated.

The machines illustrated and described are the development of C. T. Heisel, 4 St. Clair avenue, Cleveland, Ohio, and are in practical operation in Reno, Nevada.—*Eng. and Min. Journal.*

The land occupied by the right-of-way of American railroads has an area of more than 5,000 square miles, much of which is capable of crop growing.

PNEUMATIC CONCRETE MIXING AND CONVEYING IN NEW YORK SUBWAYS

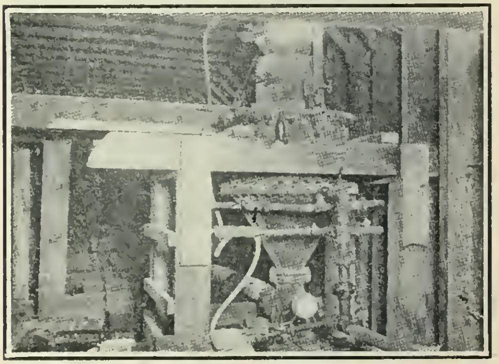
The Whitehall St. subway station at the lower end of Manhattan Island, New York, is built in a tunnel excavation 50 ft. wide and 600 ft. long quarried out of solid rock under a busy street carrying a heavy traffic. The concrete required for the roof, walls, and floor was mixed and deposited in the forms without the use of elaborate plant and without obstructing the very limited underground space or interfering with other construction operations in progress there.

The results obtained are equivalent to those that can be secured when it is possible to mix the concrete on the surface and chute it down directly to required position in the forms in an uninterrupted stream which with ordinary plant would mean a complicated, movable installation and a considerable obstruction of the street or tunnel.

METHOD OF MIXING AND HANDLING

A Ransome-Canniff pneumatic mixer and placer was installed in a convenient part of the excavation at Stone and Whitehall St. where the space it occupied was not required for other purposes.

The type A machine of improved construction was set so that the 8-in. discharge pipe was about at roof elevation and so that the charging hopper could be filled with ready-mixed gravel or subway aggregate dumped in the street above and delivered by gravity through a chute about 20 ft. long. Bags of cement were also chuted down from the street to the charging platform so that the required quantities of material for one batch of concrete could quickly be placed in the machine

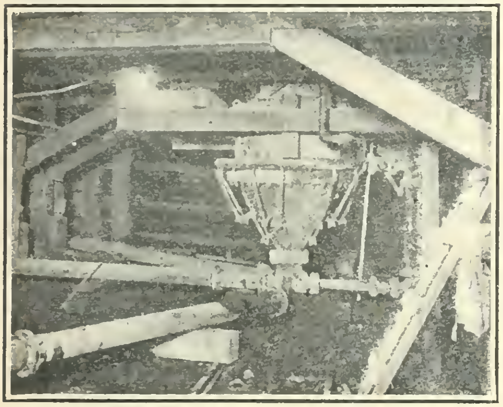


1. TYPE A MACHINE IN EXCAVATION

by operating the control levers and the mixing and conveying rapidly accomplished by the manipulation of the pressure valves.

The 8-in. flanged cast iron discharge pipe was carried along the tunnel roof out of the way of material cars and delivered ½-yd. batches a distance of 150 ft. including three standard 45 degrees bends, at an average rate of one batch every 55 sec., discharging it against baffle boards that promoted equal distribution on each side of the form where it was well spaded.

The rapidity and smoothness of the operations were accentuated by the notable absence of concrete cars and the long incline by which such cars are usually pulled up to a sufficient height for dumping into the forms.



2. PNEUMATIC MIXER AND CONVEYOR

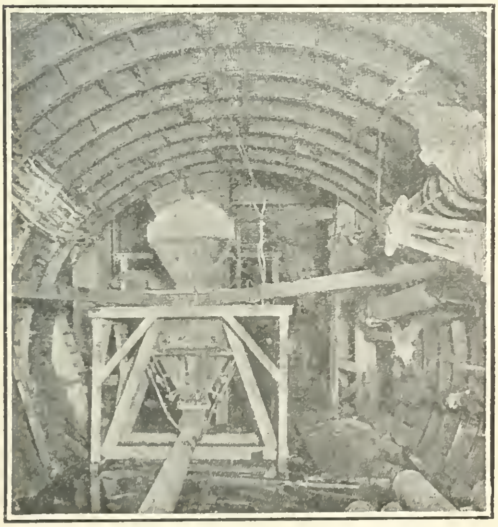
OPERATION OF PNEUMATIC MACHINE

The machine is of the latest improved type with a conical cast iron case set with the axis vertical. Midway between the top and bottom it is enclosed by a 3-in. water pressure manifold pipe supplying ¾-in. jets that discharge into the interior of the machine at two levels. Aggregate and cement are delivered through a pipe from the charging hopper to the machine and are agitated by water under pressure forced in through the manifold and its jets. When the empty upper part of the case is filled and the pressure has become equalized, the agitation ceases, the booster valve in the 3-in. air pressure pipe is opened, and the mixed concrete is driven through the discharge pipe, leaving the mixing machine ready for another batch which it receives as soon as the booster valve is closed and the charging valve opened. As long as the pressure and supply are maintained and the quantities accurately measured, the mixing and conveying goes on uninterruptedly at a rapid rate.

Part of the concrete was made with gravel of different sizes up to 2-in. and part of it was made with broken stone from ¾-in. to 1½-in. and eventually with broken stone all ¾-in. size. It was mixed and conveyed with air at 90 lb. gage pressure and it was found that the gravel concrete required less air for conveying and produced practically no wear on the pipe or the pipe bends, but that the crushed stone wore the bends materially, making it necessary to reinforce them on the outside with 3 to 5 in. of concrete.

CIRCULAR TUNNELS AND SHIELD DRIVEN TUNNELS

Pneumatic machines of the same make have been installed for the concrete lining of the subway tunnel at Flatbush avenue and Willoughby street, Brooklyn, and will be used for lining the two subway tunnels under the East River that have been driven by the same contractor. The river tunnels have cast iron tubes made of the usual segmental pieces 26 in. long connected together by bolts through interior flanges on all sides. The projection of these interior flanges from the web plates of the segments retards the flow of the concrete when placed by ordinary methods but will not prevent the concrete from being forced into all of the spaces by the pneumatic placing method which will thus obviate the necessity of filling each segment separately.

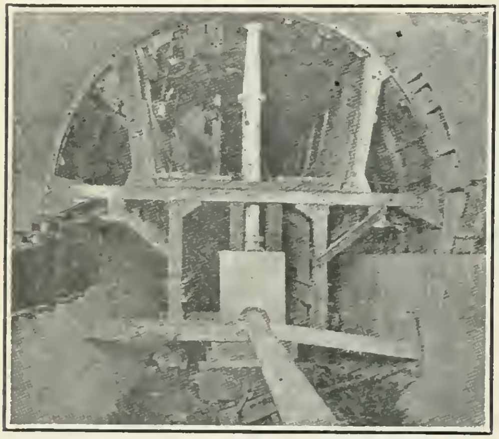


3. PNEUMATIC MIXER IN TUNNEL

At Flatbush avenue and Willoughby street the cylindrical tunnel has a permanent lining of segmental cast plates like that used for the river section, that is assembled under the tail of the excavating shield. The entire inner surface of the lining is protected with concrete forming a heavy invert and duct benches continuous with the thinner arch shell extending down below the springing line on both sides.

This thin shell is deposited by the pneumatic placing machine in the narrow space between the segmental lining and a movable, collapsible steel arch form mounted on a steel tower with an overhead working platform and clearance underneath for material cars.

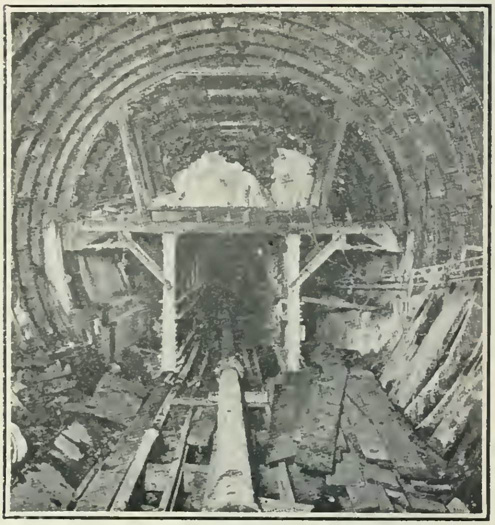
The discharge pipe from the concrete mixer is laid on the invert between the track rails and at the forward end it is thoroughly braced to prevent any lateral displacement at the 45° bend that connects with a vertical section terminating in a reducer which passes through the steel form at the crown and discharges the concrete in the required position.



4. DISCHARGE PIPE WITH VERTICAL REDUCER

The end of the discharge pipe was closed by a plug inserted in the pipe and secured there by cross bolts passing through the pipe. This plug received the impact of the concrete and absorbing its velocity caused the latter to drop through a large, horizontal hole cut in the bottom of the pipe.

The pipe extended through the end of a horizontal wooden box parallel with the pipe and penetrated the box to a point beyond the end of the hole in the bottom of the pipe. The concrete therefore flowed smoothly from the bottom of the pipe into the box and distributed through the box from which it was discharged into the space behind the wall columns. The box, 12 in. wide and 12 in. deep on the front side, was 18 in. deep on the rear side, with the bottom inclined downward toward the wall of the tunnel, and with the vertical wall of the tunnel side reaching only from the top of the box to within 6 in. of the bottom, thus leaving an open space through which the concrete flowed readily into the forms.



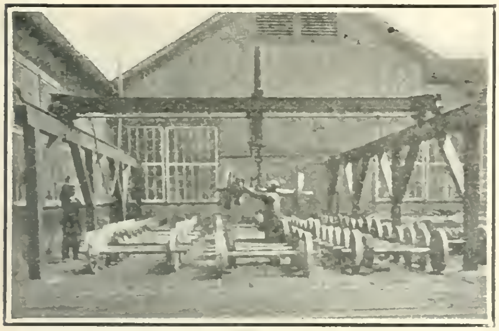
5. CONCRETE PIPE BETWEEN RAILS

AIR AND POWER REQUIRED

The amount of air required for mixing and placing the concrete varies with the length and diameter of the discharge pipe, but not in exact proportion to its dimensions, because there is a maximum demand required for the initial displacement. For conveying the ½ yard batches up to 750 ft., about 950 cu. ft. of free air per minute will suffice if compressed by a machine having a capacity to maintain a pressure of 90 lb. per sq. in.

The cost of the power can be estimated from a computation of the electricity required to operate a 150 h.p. motor that will drive an air compressor of 950 cu. ft. capacity. This motor should not consume more than 600 kw. of current in one 8 hr. shift.

The work described was designed and executed under the direction of the Public Service Commission, Robert Ridgway engineer of subways. The Flinn-O'Rourke Co., Inc., is the contractor.—*Contracting*, June, 1917.



PNEUMATIC HOIST ON TRAVELING BEAM

PNEUMATIC TRAVELING HOIST IN WHEEL YARD

To increase the storage capacity of its wheel yard and to save time in placing or removing wheels, George St. Pierre, superintendent of equipment San Francisco-Oakland Terminal Railways, devised the hoistway shown in the accompanying illustrations. The wheel storage, which is three tracks wide and about eighteen wheel sets deep, is flanked by beam trestles which carry a 70-lb, rail for the hoist carriage. This carriage is mounted on four 12-in. double-flange wheels, one of which is connected to a 36-in. power transmission wheel. The hand operation of this wheel by a chain causes the easy movement of the carriage. The home-made air hoist has a 6-in. piston and a lifting capacity of 4,000 lb. A man can easily handle a wheel set in a minute or two with this device.—*Electric Railway Journal.*

OPERATING THE TRAVELER

DANGERS OF THE METRIC SYSTEM

At a recent meeting of the Institution of Mining and Metallurgy in London, Mr. W. R. Ingalls, Editor of the Engineering and Mining Journal, President of the Mining and Metallurgical Society of America and also President of the American Society of Weights and Measures, submitted a paper entitled "Shall Great Britain and the United States adopt the Metric System?"

The writer expressed the hope to help to open the eyes of the members to a great danger with which both Great Britain and the States were threatened by the present strong metric propaganda. The subject was of vastly greater importance than was commonly comprehended and the people of Great Britain, her colonies and the United States should be roused to the importance of preserving their interests.

SHARP LINE BETWEEN DECIMALS AND THE METRIC SYSTEM

The advantages of the decimal system are so manifest in many cases that the pro-metric party is wont to cloud the issue by making it appear as if the metric system were the only decimal system. Really, there is the fundamental difference that the decimal system per se is merely arithmetic, while the metric system involves the basic units of weights and measures. Another source of confusion will be dispelled if we can eradicate the chimerical idea of establishing uniformity. From a project that would manifestly put the weights and measures of the greatest industrial nations of the world at sixes and sevens it must be evident that the result would be more discord instead of more uniformity. The substitution of metric weights for English weights would create relatively little disturbance. Of course, the changing of all our weighing scales would cost a huge sum, and the recalculation of schedules—such as railway rates —might come to something like the ransom of an empire, but after these were done, we might get on pretty well.

THE METRE IN RAILROADING

Let us consider the conditions that have been established in the railway business. The tracks are marked with mile posts. The railway gauge is 4 ft. 8 1-2 in. We might in course of time get in the habit of thinking of the latter as 1,435 mm., but manifestly it would never be convenient to refer to the mile posts as being 1.60935 km. apart, and either we should have to continue to think of miles, or else pull up the posts and replant them at km. intervals, which would be something of a job. Incidentally, our posting of highways would have to be revised, and the automobilist would mourn the day when metric legislation was enacted.

THE METRE IN THE MACHINE SHOP

In machine shops the measures would be done with the aid of standard gages, conforming to the requirements of practice and convention. These gages are based on the inch. If the metric system were made compulsory, it is obvious that there would be but two alternatives, viz., to restamp the gages with strange and unhandy figures, and wait until people became accustomed to them as, for example, to ask for a 6.35 mm. rod when they wanted a 1-4 in. rod; or else to change the standards so as to make them conform to metric units. Either horn of the dilemma is bad, but the second one—the changing of gages—would be calamitous. Some large American manufacturers have estimated that such a change would cost them individually from $500,000 to $750,000. So it is with all our affairs. Our entire system of manufacturing, of building and of doing things is based on standard units, which cannot be changed except under conditions that would mean nothing less than calamity.

THE METRE IN THE BUILDING TRADES

Does anybody imagine that a 2x4-in. joist could be anything else but a 2x4, although it might be called a 50.8x101.6 mm.; and after we were given specifications in metric measures, should we not have to translate them back into English measures, in order to make use of our tables of board measure for easy computation? Of course, we all know that a 2x4 is seldom of those exact dimensions, and we should probably call it a 50x100 mm. after we had learned the rules of the new game. But sometimes it is necessary to figure closely in connection with joists S4S, and then we know that the 2x4 is reduced to 1¾x3¾ in. How we should conveniently arrive at the exact dimensions of a nominal 50x100 mm. joist deponent sayeth not.

Any change of standards in either metric or non-metric countries is preposterous, unthinkable. We have all gone too far. Besides the colossal expense of substituting gauges the result could not be anything but a mixture. The man who needed some ½-in. bolts for the repair of his automobile would not relish the information that they were no longer made, but that he could have 10 mm. or 15 mm. bolts.

NON-METRIC TABLES

We have volumes of tables of figures devoted to the properties of structural steel. Similarly as to mechanics, hydraulics, surveying, in brief all the branches of engineering. With the metric system these would be all but useless. The compulsory adoption of the metric system would be no less preposterous than an edict that after a certain date all business in the United States—all buying and selling, all engineering, all figures—would be illegal unless done in French.

"ONLY"

The prime argument advanced for the metric system is to have international uniformity. It is stated that a long list of the countries of the world have adopted the metric system, *only* the United States, Great Britain and her *Colonies*, and Russia (of the Indo-European nations) having failed to do so. I have italicised the words *only* and *Colonies,* for therein is concealed the speciousness of this argument. If with "Colonies" we equate Canada, Australia, New Zealand, Tasmania and South Africa, we have a longer list of non-metric countries, and it comprises not only the most populous, but also the most industrial nations of the world. A correct statement of this theorem would be: Considering the Indo-European race alone, there is a much larger population that does not use the metric system than does; and their nations are far superior in industrial development, measured by iron production, let us say, to all other nations combined. The foisting of the metric system upon them would be, therefore, like letting the tail wag the dog.

THE METRE OPPOSED TO UNIFORMITY

If uniformity be the objective, it would be better to institute a propaganda to induce Germany, France and the Latin countries to adopt the English system. In this connection it may be remarked that, although Russia has a system different from either, the fundamental Russian measure of length, which is the most important of all measurese, is the foot, and the Russian foot is the same as the English.

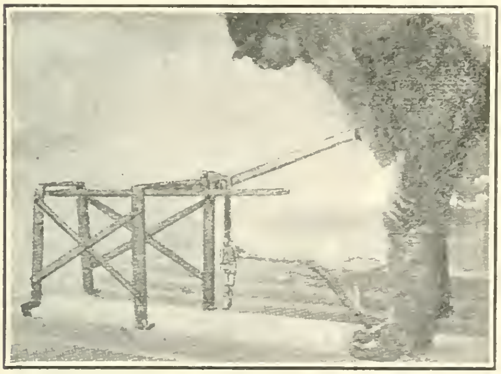
Another argument on the ground of uniformity relates to the confusion existing in the English system owing to the different kinds of tons, pounds, gallons, etc. That there is such confusion, with its inherent dangers, is true; but it is also true that the confusion is much less now than it was twenty years ago, that it is bound to experience further reduction, and that it may be eliminated entirely in a way far easier than by the introduction of the metric system. In Great Britain there is but one kind of ton, viz., that of 2,240 lbs. In the United States the English, or long ton, is employed to far less extent than formerly, and in the main we have standardized the ton of 2,000 lbs. That we should have two pounds—the avoirdupois and the troy—is annoying, but the annoyance is now more academic than practical, for the troy pound is seldom used. Similarly have the differences among gallons, bushels, etc., lapsed in the main into innocuous desuetude. But with respect to confusion, the skirts of the metric system are not clean. As a statistician of nearly thirty years' experience I may say that I have fallen into more errors over the zentners and doppel-zentners of metric Germany, and the quintals and metric-quintals of Chile, than I have over the pounds of England and America and the poods of Russia.

The third metric argument is the ease of the calculations, especially the correlation among measures of length, volume and weight. It may freely be admitted that there is some merit in this, but the English system is not quite helpless in this respect; and the superior merit of the metric system is far short of being a determining factor, quite apart from its calamitous effect in overthrowing existing standards and upsetting the mode of thought of the people, which of course are the major considerations.

In concluding his paper the author emphasizes the point that his arguments are not directed against the metric system, but rather against the propaganda for the *compulsory* adoption of it.

COMMERCIAL AERONAUTICS

At a recent meeting of the Aeronautical Society of Great Britain a paper on "Commercial Aeronautics" was read by G. Holt Thomas, one of the pioneers of aviation in that country. Mr. Thomas said that in his opinion aeronautics would revolutionize the world not only from a commercial point, but also from a humanitarian point much more than it had revolutionized war. He said he was not one of those who thought commercial aeronautics were going to beat out of existence the railroads and other forms of transport, but rather that flying would act as an adjunct to present modes. From a business point of view speed was everything. The airplain would enable a business man to leave London in the morning, go to business in Paris and be home again to dinner. It would take him to Bagdad in a day and a half or to New York in two days. Ceylon would become 2¾ days from London, Tokio 4½, Sydney five, Cape Town 3½, and Vancouver 3. As for the question of cost it would be possible to run a profitable air service between London and Paris at $25 a passenger, a cent an ounce for mails and 50 cents each for parcels of three pounds. A Constantinople or Moscow journey of twenty-four hours might involve a cost of $125 a ticket.



PNEUMATIC DRILL MOUNTING FOR LARGE SHEETS

To avoid the trouble and expense of handling long steel sheets over a drill press, a pneumatic drill supported by a home-made carriage is used in our shops as shown in the photo. The carriage has a very wide range over which to operate, being arranged to slide lengthways of the sheets while the drill itself can be moved back and forth across the sheets. There is a lever by which hand pressure is exerted on the drill, and when this pressure is released a coiled spring raises the drill out of the work and it is ready for the next hole. This device allows the sheets to lie flat at all times, and, as it can be operated by one man, it saves a great deal of the labor in handling the long sheets.—*G. B. Sisson in Electric Railway Journal.*

THEORETICAL AND ACTUAL AIR DELIVERY OF COMPRESSORS

BY ROBERT S. LEWIS

Air compressors are rated by their manufacturers on the basis of piston displacement, or volume swept through by the piston, expressed in cubic feet of free air (air as it may be under the local atmospheric conditions of pressure and temperature) per minute. If compressors delivered this quantity of free air as compressed air such a rating would be correct; but various factors modify the intake capacity of a compressor, so that it may be much less than the piston displacement. The ratio of the free air taken into the compressor, stroke after stroke, to the piston displacement is called the volumetric efficiency of the machine, and may be expressed as an equation:

$$(1)\quad Ev = \frac{\textit{cu. ft. of free air taken into cylinder}}{\textit{piston displacement in cu. ft.}}$$

The important factors which modify volumetric efficiency are clearance, volume of piston rod, heating of the air before compression, leakage of air past the piston and also leakage of intake and discharge valves, too small area of valves and mis-timed operation of mechanically controlled valves.

The space between the piston when at the end of its stroke and the cylinder head is filled with compressed air which cannot be expelled. During the return stroke this air must expand until it is at atmospheric pressure again before any free air can enter the cylinder. If this clearance space is large the free air intake capacity of the cylinders is materially reduced. In well-designed single stage compressors the clearance, expressed as a per centage of the displacement per stroke, may be as low as 1 per cent. for the large sizes and 2 per cent. or more in other cases. This means that for a low clearance value the distance between piston and cylinder head at the end of the stroke may be only $^1/_{16}$ or even $^1/_{20}$ in. The effect of this clearance increases as the ratio of compression (final absolute pressure to initial absolute pressure) increases.

For large clearance ratios the piston must travel a considerable part of its stroke, while the air is re-expanding, before any free air can enter the cylinder. If it were possible to compress to 5000 lb. per sq. in. in a single cylinder of ordinary design no air at all would be taken in during the return stroke, the air in the clearance space expanding to entirely fill the cylinder.

Assuming here for convenience that this clearance air expands isothermally, which may be nearly as correct as to consider that it expands adiabatically, the effect of clearance may be calculated as follows:

Let Ec=volumetric efficiency depending upon clearance.

C=clearance expressed as a decimal.

r=ratio of compression$=\frac{P}{Pa}$, P being final absolute pressure in lb. per sq. in., and Pa being the initial absolute pressure. (Absolute pressure is gage pressure plus atmospheric pressure).

(2) Then $Ec=1+C\ (1-r)$.

Thus, when compressing from an atmospheric pressure of 14.7 lb. to 100 lb. gage with a clearance of 2 per cent. we have:

$$r=\frac{100+14.7}{14.7}=7.8 \text{ and } Ec = 1+0.02\ (-6.8)$$

$=.864$, or 86.4 per cent.

In case the clearance of a compressor is not known, it may often be determined, as is done with steam cylinders, by measuring the volume of water required to fill the clearance space.

The effect of clearance upon volumetric efficiency is lessened by using two stage compression. Since the air is not compressed to the final pressure in a single cylinder, the percentage of the volume of the low pressure cylinder occupied by the expanded clearance air is reduced. The piston rod occupies space on one side of the piston, consequently the displacement per revolution, or double stroke, corrected for clearance, less the volume of the piston rod, will give the free air intake capacity of the compressor per revolution.

Under constant pressure, the volume of a given weight or quantity of air is proportional to its absolute temperature (460F.+thermometer reading). At 60 deg. F. a given volume of air will expand $^1/_{520}$th of its volume at this temperature for each degree, Fahrenheit, of rise in temperature. If one cubic foot of air at 60 deg. is heated to 100 deg. as it enters the compressor its volume will be increased

$^{40}/_{520}$ths, or approximately 8 per cent. In other words, a cubic foot of air at 100 deg. is equivalent to 92 per cent. of a cubic foot of air at 60 deg. The power required for compressing a cubic foot of air, once it is in the cylinder, is independent of the temperature of the air. This means that the colder the air is when taken into the cylinder the less will be the number of cubic feet required to give a desired result. For this reason care should be taken to get the air into the cylinder at as low a temperature as possible.

The intake conduit for the compressor should be made of non-conducting material, such as wood, brick or concrete, and should draw air from the coolest place available, never from the compressor room itself. The cross-sectional area of the conduit should be equal to at least one half the area of the piston, in order that the air may flow with perfect freedom. In hot and dusty localities it has been found beneficial to draw air from the interior of a framework covered with burlap or sacking, which is continuously drenched by spray of water. This arrangement not only cools the air but removes the dust at the same time.

If a compressor has poorly designed intake passages, the air as it enters the cylinder may be at a temperature several degrees above that of the atmosphere. The metal of the cylinder becomes quite hot after a compressor has been running for an hour or more, and, after traveling through long and narrow intake-passages the air may be heated to 100°F. or above.

Let Tc = absolute temperature of the air after entering the cylinder, and Ta = atmospheric absolute temperature, then

$$E_v = E_c \frac{T_a}{T_c} \qquad (3)$$

This is the expression for volumetric efficiency modified by clearance and heating of the intake-air.

Leakage past valves and piston will further reduce the intake-capacity of a compressor. If the area of the intake-valves is too small the cylinder will not be filled with air at full atmospheric pressure, and, if the area of the discharge valves is too small, all the air compressed will not be discharged. Poppet valves depend upon a difference in pressure on the two sides of from 3 to 5 oz., for their action and may reduce volumetric efficiency by as much as 2 to 4 per cent. Mechanically operated valves of the Corliss type are very satisfactory, but they must be maintained in correct adjustment.

Though the effect of clearance and of heating the air before compressing can be calculated by the formulas it is well to bear in mind that the results so found may not always agree with the actual conditions of operation. The leakage of air past valves and piston, the choking of air-passages, and bad valve-action, are variables that cannot be determined by formulas. Volumetric efficiency is most accurately determined by measuring the air delivered and comparing it with the displacement of the compressor. Such a method includes all factors affecting the performance of the machine.

When the ratio of compression is large the final temperature of the air in the cylinder may be very high. The relation of temperature to volume and pressure is given in the following equation:

$$T_2 = T_1 \left(\frac{V_1}{V_2} \right)^{n-1} \qquad (4)$$

$$T_2 = T_1 \left(\frac{P_2}{P_1} \right)^{\frac{n-1}{n}} \qquad (5)$$

The subscripts 1 and 2 indicate initial and final conditions respectively. P and T are in terms of absolute pressure and temperature. Volumes V are in cubic feet. The value of n for perfect adiabatic compression is 1.406. For an initial temperature of 60°F., a final gage pressure of 100 lb., and atmospheric pressure of 14.7 lb., the final temperature of the air would be

$$T = (460+60) \left[\frac{14.7+100}{14.7} \right]^{0.29} = 520(7.8)^{0.29} = 931^\circ \text{ abs.} = 471^\circ\text{F.}$$

Should some of the hot compressed air leak back into the cylinder, or should the ratio of compression be increased by throttling of the intake-air through sticking of the valves, the temperature may be even higher than the above theoretical value. That such high temperatures are reached in practice is shown by the explosions that occasionally take place in compressors and receivers.

An air cylinder, unlike a steam cylinder, requires only a small quantity of oil, a drop once in four or five minutes should ordinarily be sufficient. The use of too much oil causes an accumulation of carbon that may choke the valves and passages. Kerosene, often employed for cleaning valves, has a flash point of 150°F. or less, and ordinary lubricating oils have flash points varying from 330° to 425°F. In view of the high temperatures that may be reached in the cylinder, such oils are obviously a source of danger. Only a thin air cylinder oil, with a flash point of 600° to 630°F. should be used. For cleaning valves, a mixture of soft soap and water should be fed through the lubricating cups once or twice a week. As a safety measure, it is advisable to place a thermometer or fusible plug in the discharge pipe, and as near the compressor as possible.

For pressures up to 60 lb. per sq. in. single-stage compression is satisfactory, but for pressures from 60 to 150 lb., which are commonly used in mining work, two-stage compression is preferable. The ratio of compression in a cylinder of a two-stage compressor is equal to the square root of the ratio of compression in a single-stage compressor delivering air at the same final pressure; consequently losses in capacity due to clearance and leakage are materially lessened. The inter-cooler of a two-stage compressor will reduce the temperature of the heated air from the low-pressure cylinder nearly to that of the atmosphere before it enters the high-pressures cylinder; therefore the final temperature of the air is lower than for single-stage compression, and lubrication is facilitated. However, the sticking of valves, or the choking of passages, may cause such a high temperature to be reached in the high-pressure cylinder that an explosion will occur even in a compound compressor. *Mining Press.* Some liberties taken with the text.

LIQUID FIRE IN THE WAR*

Liquid fire is a weapon of value principally because of its demoralizing effect upon those attacked. There have been some casualties resulting from liquid fire, but it is the psychological effect that is sought. The apparatus usually consists of a metal tank holding about 4 gal. of liquid to be burned, a section of pipe from this tank to a rubber hose at the other end, in which there is a smaller metal pipe about a yard long fitted with a nozzle and a friction igniter, as well as an oil-burning wick. There is a valve near the tank and another near the nozzle. Benzol, from coal tar, and crude oil are used in equal proportions and are carried in the tank under a pressure of approximately 300 lb. per sq. in., this pressure being maintained by compressed nitrogen, an inert gas having no effect upon the contents of the tank. The tank and accessories are carried by one man, while the nozzle is carried by a companion when liquid is being burned. Or it may be fixed in position and operated by the same man who carries the tank.

In use a cap is drawn from the end of the nozzle and a wick burning kerosene or similar oil is thereby lighted, since the cap is a friction igniter. The oil is then turned on and is ignited as it leaves the nozzle under great pressure. The result is a flame of burning oil about 30 yd. long. For two-thirds of this distance the flame is straight, but it then turns up as does any other flame. It may be directed against the ground, but care must be taken not to deflect it too sharply as it may strike the ground and turn back towards those operating the device. It is therefore not well suited to turning down into a trench.

It is said by an expert that liquid fire is not so effective now that it is understood by the troops and means for defense have been worked out. It can be readily understood, however, that a number of such devices, with the roar of the escaping oil, when used together, gave a means of demoralizing the defenders of a trench, especially at night, and in the beginning was a valuable accessory, especially by raiding parties.

The range of complete combustion of mixtures of gasoline vapor and air is very narrow, according to an investigation made by the Bureau of Mines, which showed that it was limited to mixtures containing only between 1.5 and 2.5 per cent. The amount of carbon dioxide produced reaches a maximum at 2.5 per cent. of gasoline vapor. At this point, as the percentage of gasoline vapor increases, carbon monoxide begins to form. At 4.1 per cent. of gasoline vapor there is produced 14.0 per cent. of carbon monoxide.

The construction of a railroad tunnel 13 miles long through the Hindu Kush mountains between Turkestan and India is being considered.

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W. L. SAUNDERS, - - - Editor
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CHAS. A. HIRSCHBERG, - Business Manager
W. C. LAROS, - - Circulation Manager

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RUSH THE AIRPLANES

The present month sees the completion of the third year of the world's life-and-death struggle, and the occasion suggests inquiry as to the outlook. We may believe that we are nearer the end than we were at the beginning, but how much nearer no man may say. We of the United States, compelled to shoulder our share of it, are proceeding with our preparations in a way which seems to be characterized by anything but haste. There may be magnitude of plan which is not incommensurate, but when is telling effectiveness to be reached at the rate we are going.

The futility of much of our most demonstrative preparation is too evident. It seems to be now universally, if only tacitly, conceded that masses of men backed by inexhaustible munitions, although they must have their weight, are not to be the determining factors. The art of war has been transformed, and the new devices which have demonstrated their superiority in strategic facility and in ultimate destructiveness, which is the test of war efficiency, are our present hope for the closing of the wretched business.

It seems to be for the submarine and the airplane to bring the fight to a finish. The toll the submarine is taking is not to be too lightly spoken of, but it suggests no finality. It seems to be adapted only to the purposes of the central powers, and the allies have no use for it as there is no commerce for them to destroy. The possibilities of submarine destructiveness may be said to be quite fully revealed and the means of thwarting it seem to be rapidly developing, but we have as yet no hint of the unlimited resources of achievement the airplane commands. It is a most invaluable and now an absolutely necessary adjunct to both the army and the navy, whether for offensive or defensive operations, and is in itself an independently operating aggressive force with an unlimited field all its own.

The airplane, unlike the submarine, is equally adapted to the purposes of both the opposingforces and can be used with equal success by either side, so that we may be quite certain that the central powers will be rushing the fliers out and employing them by wholesale in their unlimited schemes of frightfulness, and it is up to us to concentrate our resources of production to meet the supreme emergency.

letting this take precedence over all else. Twenty thousand air planes and a hundred thousand aviators is not an extravagant estimate for our quota of the immediate requirement, these to be followed by the improved apparatus which will inevitably be developing as long as the agony continues.

The airplane, which must be by this time sufficiently standardized, is of a character almost ideal for rapid reproduction under American manufacturing systems. The machine in detail consists of small parts quickly produced and easily handled, and these could be distributed among a hundred establishments ready equipped with tools easily adaptable to the special requirements.

The assembling and the trying and adjusting could go along quite as rapidly as the aviators could be trained to use them. It is for the nation to show what it can do in this line, and especially how quickly it can do it.

TUNNELS AND MORE TUNNELS FOR GREATER NEW YORK

BY JOHN F. O'ROURKE

For more than forty years I have watched with keen interest the building and development of the great Port of New York, having been connected with its bridges, buildings, streets and rapid-transit roads all that time, both as engineer and contractor. In all these years it has been a sort of hobby with me to forward the interests of Manhattan, and I am grateful for the fact that my part, however modest, was that of being a part and parcel in the participation in its growth. The building of the great Pennsylvania tunnels by my company across the North River, which bring hundreds of thousands of people daily into New York without causing any congestion or interruption of traffic, is one of the great things which have happened to the city. I cite the Pennsylvania tunnels as an example. The plans by which they were built have been followed by other engineers in the construction of tunnels since.

SAFETY OF TUNNEL BUILDING

The building of tunnels in the twentieth century is safe, as far as life is concerned, there being much less risk for a tunnel worker than there would for one performing labor on a skyscraper. In fact, to my way of thinking, the danger to life is far more hazardous working on structures reaching skyward.

The most essential point in the building of tunnels is to safeguard the overhead property, such as the streets, houses, and buildings. The method of filling the spaces outside tunnels which are left by the shields as they move forward along the tunnels which are built inside their tails leaves no spaces in which a settlement can occur. The recent tunnels built for the Public Service Commission under the East River and adjoining streets have been built by this method without any sign on the surface of their construction and existence, nor have either the residents or the public had any knowledge of the work below from anything that could be seen by them. There is not a break or a sign of any outward disturbances or any undermining of buildings, or, as a matter of fact, no one, even if one had a technical knowledge of engineering, could realize that one hundred feet or more below a great work was going on in the building of a tunnel.

These are days of great opportunity for New York; I, for one, look for all of us to keep our heads and demonstrate our capacity and fearlessness in pushing forward, not alone in tunnel-building, but in all kinds of development and improvement, thus aiding and contributing to keep New York the great port, and adding to and making it all the time a greater one, with more docks, more railways, that will add greatly to the number and convenience of our citizens and the further development along lines for capacity, economy, and efficiency of our port, thus helping materially to maintain its supremacy over the other ports of the world.

MORE AND GREATER TUNNELS

Among other things, I look for tunnels that will connect Staten Island to New York, both for railways and automobiles; also to New Jersey. Then there would be built tunnels exclusively for automobile traffic under congested streets, as outlined in the New York *Evening Post* with reference to Fifth avenue in one of its recent issues. I wish also to state my belief that the engineering of what might be termed municipal facilities, such as streets, docks, and tunnels, is still in its infancy, and far greater accomplishments are yet in store. For the present, as stated in the beginning of this article, there is a new method by which subways and tunnels may be built without the usual penalties of destruction of business and comfort along the line. The solution of the problem of absolute safety to streets and property overhead is the keynote to modern tunnel engineering.

CHEAPNESS OF CONSTRUCTION

The great point in connection with this is the saving of expense in preventing damage to buildings or interference with the use of the streets by either tenants or the public. By the method of "gravel packing," a shield-driven tunnel connecting Staten Island with New York, consisting of four racks for railways or automobiles, could be constructed at a cost much less than that at which two single-way tunnels could be built by any other method of tunnel construction.

Thus the introduction of multiple way tunnels brings in a new era in municipal engineering, because it multiplies their capacity and reduces their cost. Another vital point in my plan for tunnel construction is the great saving of time and cost brought about by this up-to-date method and employment of powerful machinery and thoroughly efficient methods of procedure. Our one aim should be to concentrate all forces to make the Greater Port of New York the leading port of the world. —*Evening Post,* New York.

ABOUT ATMOSPHERIC HUMIDITY

BY B. V. R. GAGE

The instrument in the weather bureau kiosk marked "relative humidity" is supposed to show the percentage, by weight, of water vapor in the air, 100 per cent. being when the atmosphere can hold no more in the form of steam. The maximum weight of steam that the atmosphere is capable of holding is dependent on, and increases with an increase of, the temperature. The action of this hygrometer depends on the expansion and contraction in length of a hair or fiber as it increases or decreases in moisture content.

Another common device for measuring the relative humidity is a combination consisting of two ordinary thermometers, one having the bulb covered with a wet cloth or a wick extending into a vessel of water. In the use of this instrument the wet-bulb and the dry-bulb temperatures are taken. If they are the same, the humidity is 100 per cent., but when there is a difference it is necessary to consult tables in order to obtain the relative humidity. The engineer generally uses a "sling psychrometer," which is essentially a "wet and dry bulb" outfit so mounted that it can be rapidly revolved. The readings are the same as with the stationary type, but a table of different numerical values must be employed.

DETERMINING RELATIVE HUMIDITY

The most accurate and also the most logical method of determining relative humidity is the dew-point apparatus. With this a surface is cooled until moisture is condensed from the air. The temperature at which condensation begins is the boiling point corresponding to the actual vapor pressure of the H_2O in the surrounding space. The corresponding pressure may be found from steam tables, using the dew-point temperature; the difference between the actual air temperature and the dew-point temperature gives the degree of superheat. Consulting a steam table, the weight per cubic foot of superheated steam under these conditions may be found; call this $M\ act$. Then look up the weight per cubic foot of dry and saturated steam at the air temperature and call this $M\ sat$. The relative humidity is $M\ act \div M\ sat$.

In order to understand about this matter of humidity, let us consider a few things to which perhaps we have never given much attention.

Water in a teakettle on a hot stove first boils, a part of it turns to steam and drives all the air out of the kettle. In the teakettle there is then only H_2O in the liquid and gaseous states. The steam has nearly free access to the air, so the pressure inside the kettle is not much greater than atmospheric. That means that the vapor pressure in the kettle is about 14.7 lb. per sq. in. abs., with a corresponding boiling point of about 212 deg. F. So far we have considered only equilibrium between two phases, in which the vapor phase is maintained free from other gases and atmospheric pressure is maintained in the vapor space. As the steam leaves the kettle, other things happen. The vapor is separated from contact with the liquid, the total pressure in space remains the same, and the steam mixes with other gases of a lower temperature. Right here remember that steam is invisible, that what we see is the result of light reflection from minute drops of water in the steam.

ANOTHER EXAMPLE

Now let the teakettle go for a time and take up another homely matter—what happens to the clothes on wash day. They are hung out to dry, the water which they contain evaporates and goes off into the air as invisible steam. The temperature of this water never reaches 212 deg.; in fact, during the winter, the clothes freeze solid and stay below 32 deg. until they are dry. The water has changed from ice to steam and yet has never gone above the freezing point. A consideration of the molecules may help toward an understanding of what happens. Put a pan of water in a closed vessel, the whole to be kept at a constant temperature. For the purpose of this example it makes no difference what the pressure is; it can be a vacuum, atmospheric or several atmospheres, without appreciably altering the results. After some time has elapsed, the space inside the vessel becomes saturated with water vapor, humidity 100 per cent. H_2O; the pressure corresponds to the temperature with dry and saturated vapor.

MOLECULE ACTION

Another homely example of this type is the use of a closed vessel to keep bread from drying. Now the water consists of molecules in magnitude somewhat similar to the particles of dust of the earth's surface. For the given temperature we can know the average kinetic energy of each molecule, but actually we cannot know the velocity of a given molecule at a given time. It is like the life-insurance business. The actuaries can take a large group of men and tell how many will die at 40 years old, how many at 45, etc., but they cannot tell at what age a particular man will die. Some of the molecules have a much greater velocity for an instant and at times shoot through the surface of the liquid and get to wandering around in the space above. When enough of these molecules are in the space above so that there are just as many going back into the liquid as there are coming out, then the condition of equilibrium is established between the liquid and the vapor phases for that temperature, or in other words, we have the vapor pressure for that temperature. If the space is not inclosed, some of the molecules can escape, but nature tries to build up and maintain such equilibrium.

In the case cited the temperature was to be maintained constant. If the water vapor can escape from immediate contact with the liquid, so that the vapor pressure cannot rise to the value corresponding to the saturated condition, and if heat is not supplied, then the temperature will be lowered. The molecules with the greatest energy escape, thus lowering the average energy of the mass of molecules. This loss of energy is shown by decrease of temperature; witness, the porous earthenware jugs used to cool drinking water.

DIFFERENT GASES IN THE SAME SPACE

In thinking of this phenomenon, it is best to consider the atmosphere not as air, but as space. The air is made up mainly of nitrogen, oxygen and water vapor. If a cubic foot of air be taken, each gas will be found in every portion of it. That is, each one occupies the whole space. The total pressure exerted will be about 14.7 lb. per sq. in. and is the sum of the partial pressures of each one of the constituents. If any one of the components is to be placed under 14.7 lb. pressure, it will be necessary to compress it into a much smaller volume. If possible to separate the gases, each might be compressed to 14.7 lb. and then the sum of the volumes would be one cubic foot, the same as in the first place. Each gas which makes up air may be treated as though the others were not present, provided the total volume and the partial pressure are used.

Fog is caused by reducing the temperature of the air below the boiling point corresponding to the vapor pressure. In case of fog, the humidity may be said to be greater than 100 per cent., although there are some serious objections to such a usage. When there is fog, the water vapor in the air is in the form of wet steam. At 100 per cent. humidity the form is dry and saturated vapor; at less humidity, it is super-heated steam.

On a foggy day the humidity in the boiler room is generally less than 100 per cent. As the wet steam enters the room, it receives sufficient heat to evaporate the water and then to superheat the steam. More weight of vapor can be held in unit volume when the temperature (and hence vapor pressure) is higher.

The loss of heat in boiler operation due to humidity is negligible. In the first place the weight of the water vapor is relatively very small. And then the heat loss per pound of vapor is the product of the specific heat of steam and the increase of temperature from the room to the flue. The specific heat value is about 0.45 for usual humidity conditions and, $Loss = WC\ (tf - ta)$.

The heat loss due to the combustion of the hydrogen in the volatile matter is the sum of a portion of the heat of the liquid, all the latent heat and some heat of superheat. Represent weight of water by W, heat of liquid by q, heat of vaporization by r, temperature by t, specific heat by C; subscripts $a =$ air, $f =$ flue, $h =$ vapor pressure, $212 =$ atmospheric pressure. The foregoing statement then is shown by

$$W[q_h + r_h + C\ (t_f - t_h)]$$

(If q_h is corrected to fuel temperature it may become negative) and a commonly used expression,

$$W[(212 - t_a) + r_{212} + C\ (t_f - 212)]$$

is not correct.

Inspection of a B.t.u-entropy chart for steam shows that the total heat of one pound of dry saturated or superheated steam, for pressures less than 3 lb. per sq. in abs., is practically a function of the temperature and independent of the pressure. The vapor pressure in the air or flue gas can hardly reach 3 lb. So the following formula* is true:

$$Loss = W\ (1090.7 + 0.455t_f - t_a)$$

A consideration of the heat loss due to combustion of hydrogen opens the question of higher and lower heating values. The former is obtained when the water thus formed is all condensed and cooled to the original temperature of the fuel, along with all the other products of combustion. A lower heating value is obtained when the water is only partly condensed or not condensed at all, or when the products of combustion are not cooled to the original temperature, or by a combination of uncondensed water and insufficient cooling. There are an infinite number of lower heating values for any fuel containing hydrogen. When the term lower heating value is used, it is necessary to inquire under what conditions it was determined. In order to make an experimental determination of the higher heating value, it is necessary to have the air and the fuel supplied for combustion at 100 per cent. humidity and at standard temperature, to have the products of combustion cooled to this same temperature and humidity, to separate out all drops of water, and to have the products of combustion occupy the same volume as the elements and at the same pressure. It is not hard to recognize the difficulties of this task. So we do the best we can and make corrections when necessary.

From the preceding facts regarding the action of the water molecules, it is evident that the water in an exploding boiler will tend to expand to the vapor pressure in the surrounding space. What this vapor pressure will be depends upon many factors, including the rate of removal of water vapor, the temperature, etc. It certainly is not correct to assume 14.7 lb. and 212 deg. without proof. And proof is impossible. The vapor pressure may be either greater or less than 14.7 lb. Then there is the other factor of violent actions tending to go through equilibrium to the opposite extreme.

History furnishes examples of peoples awfully oppressed, revolting, and when liberty is gained temporarily turning it into license. A more technical example is a compressed spring; when the load is suddenly removed, the spring extends nearly as far as it had previously been compressed. There is no telling how gradually the pressure is relieved from the water in the exploding boiler, as it will build up vapor pressure in the immediate vicinity, set up waves of high and low pressures and otherwise introduce various conditions.—*Power.*

A MINING DRILLING CONTEST

For many years in some of the important mining centers of the West hand drilling contests have been a feature of the Fourth of July doings, and the results of some of these contests have been recorded in previous volumes of Compressed Air Magazine. This year at Tonopah, Nevada, a so-called Jackhammer contest was held. This designation of the drills as a class was of course incorrect, as the name "Jackhamer" is a copyrighted trademark of a single company and applies only to the drills of its manufacture.

In this event there were forty-two contestants, including among them representatives of all the manufacturers of unmounted, self-rotating hammer drills. The true Jackhamer (Type B C R-430) won first, third and fourth places, and the Sullivan Rotator (Type D P-33) won second place. The drilling was in Rocklin granite, each contestant being allowed eight minutes in which to connect his hose and drill as great a footage as possible.

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*"Experimental Engineering," Carpenter and Diedricks, p. 467.

The winning Jackhamer drilled 61 7-16 inches in the time, and the Rotator which took second place drilled 58 7-8 inches.

NOTES

The article upon page 8403 of Compressed Air Magazine, June, 1917, entitled "Two Baby Hoists Run a Disabled Derrick" was reproduced without change from Engineering Record, March 10, 1917. We much regret that thankful acknowledgement was not made at the time of our republication.

Andrew Lemon, an oil well shooter, and Fred Baker, oil field worker of Okmulgee, were blown to pieces recently when 80 quarts of nitro-glycerin which they were taking to the Baldhill field, were exploded by a jolt to their automobile.

The mints of the United States purchase bullions from all the precious-metal districts. These bullions are sold for their gold and silver contents, but the government makes a neat profit through the recovery of various other precious metals, such as palladium and iridium.

Rio Tinto, the oldest copper mine in the world, once worked by the Romans, and before them by the Phoenicians paid to its British owners last year the sum of $10,500,000. That represents an earning capacity of 95 per cent. on the capitalization of the company.

It would seem the wiser policy to leave the adoption of the metric system optional, as we and our American cousins have done hitherto, till the civilized nations have agreed upon a really correct unit. Anyone who travels in the countries where the metric system is in force knows that in common practice it is not universally adhered to, but that the old measures and weights are still used by the masses.—*The Engineer*, London.

Something like 500,000,000 rabbit skins are imported into this country yearly, principally for the manufacture of felt hats. A fair grade of fur from Australian rabbit skins has a value of from $2.50 to 5 lb. The fur is skilfully shaved off the skins; during this process the skins are shredded so as to present an appearance not unlike excelsior packing. Glue produced from these skins is remarkable for its elasticity—freedom from mold and odor—and for lining oil barrels is superior to any other material available.

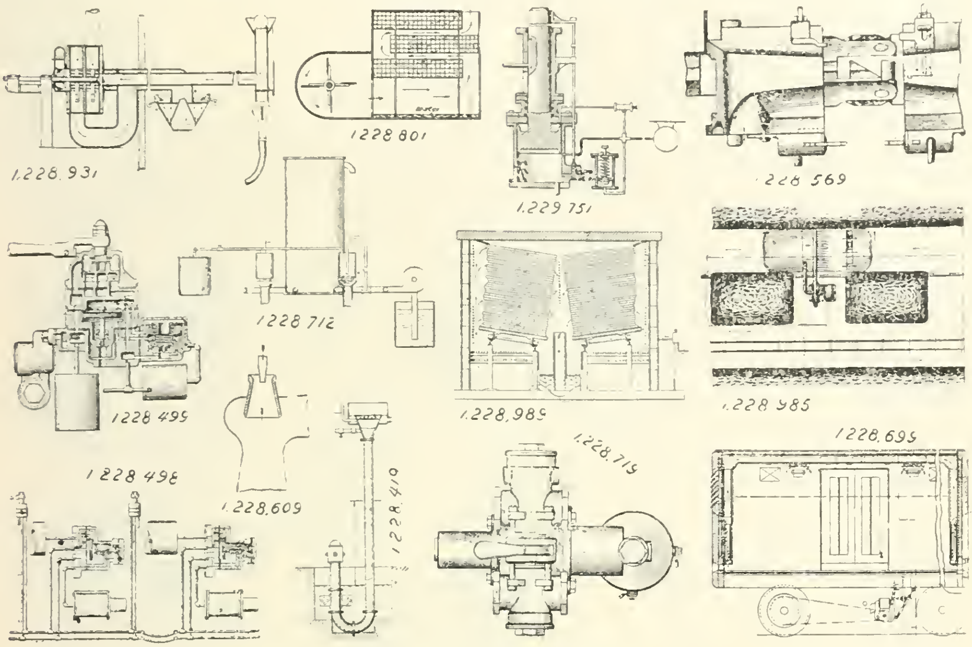
German experiments in the use of acetylene gas in internal combustion engines show that the proportion of air to gas to avoid sooting should be as 12.02 is to 1. The maximum compression for the mixture is about three atmospheres. One ton of carbide is sufficient to produce 10,000 cubic feet of acetylene.

A simple high vacuum pump, recently developed at the United States Bureau of Standards, can be built entirely of glass by a reasonably skillful glass blower and requires for its operation only a bunsen burner and a water aspirator. The remarkable feature of this exhauster is that it is capable of giving vacua down to better than 0.001 mm. pressure.—*Commerce Reports.*

The gross total of motor cars, including commercial cars, registered in 1916 was 3,512,916, according to figures compiled by the U. S. Office of Public Roads. This is an increase of 1,067,332 over the number registered in 1915. The several states collected in registration and license fees, including those of chauffeurs and operators, a total gross revenue of $25,865,369. Of this amount 92 per cent, or $23,910,811, was applied directly to construction, improvement, or maintenance of the public roads in 43 states.

There probably was never a time in the history of the mining industry when so many sound, solid, well-managed and dividend-paying concerns presented themselves to the public. During the last 30 years mining has enormously expanded, and has emerged largely, we had almost said entirely, from the category of speculation, and reached the status of an industry. Instead of being regarded as a neck-or-nothing venture—a sort of horse-race gamble—mining to-day presents itself with credentials of stability and success which cannot be denied.—*Mining World*, London.

To completely extinguish mine fires not only must the flames be put out, but the heat must be dissipated. This is the harder part of the work. The temperature may long remain so high that when air is supplied the fire will break out again. Speaking at meeting of the Manchester Geological and Mining Society, A. Stoker declared that a fire that had been stopped off for 28 years, and had died out for lack of oxygen, broke out again in several local conflagrations when supplied with air, which is a strong argument in favor of water quenching as against gas quenching.



Pneumatic Patents June 5

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JUNE 5

1,228,419. PRESSURE CONTROL IN PUMPING. George H. Eckert, Syracuse, N. Y.

1. The method which consists in reciprocating a column of liquid with a velocity sufficiently limited to preserve the coherence of the column and having sufficient bulk and path of travel to acquire useful momentum, utilizing an expansive force to cause one stroke of said reciprocation, and restraining a return stroke by a below atmospheric pressure to the rear of the column in order to reduce the pressure developed.

1,228,498. STRAIGHT-AIR EMERGENCY-BRAKE. Walter V. Turner, Edgewood, Pa.

1,228,499-50. ENGINEER'S BRAKE - VALVE DEVICE. Walter V. Turner, Edgewood, Pa.

1,228,569. CAR AND AIR-HOSE COUPLING. William S. Knisely, Benton Harbor, Mich.

1,228,608. FLUID-OPERATED EJECTOR. Arthur Edwin Leigh Scanes, Ashton-upon-Mersey, England.

1,228,640. APPARATUS FOR PREPARING FOOD. John D. Belton, Crowley, La.

1. In a device of the class described, a heating and mixing chamber, the former communicating with the latter, heated rollers in said heating chamber, a belt conveyer on said rollers, a spiral conveyer in said mixing chamber, an aspirator chamber communicating with said mixing chamber, a spiral drum in said aspirator, means for rotating said conveyer and drum, and means for creating air currents in said aspirator, substantially as described.

1,228,699. APPARATUS FOR MAINTAINING A UNIFORM TEMPERATURE IN RAILWAY FREIGHT-VANS. Arthur William Prim, Liverpool, and Francis William Roper, Sheffield, England.

A self contained freight car having air casings for the circulation of air within the car so that it passes through the freight contained therein, means located at the end of the car for heating the air as it circulates, fans for circulating the air through the air casings, adjustable means located at the ends of the car and communicating with the atmosphere for ventilating the car, valved air ports communicating with the atmosphere at the ends of the car and in proximity to said heating means, whereby the car may be completely closed and circulation of the heated air effected therein, or it may be ventilated through openings to the outside air.

1,228,712. APPARATUS FOR STERILIZATION OF LIQUIDS BY OZONE. Jan Steynis, Bay Shore, N. Y.

1,228,719. ELECTROPNEUMATIC TRIPLE - VALVE MECHANISM FOR COUPLING SYSTEMS. Charles H. Tomlinson, Mansfield, Ohio.

1,228,801. APPARATUS FOR MOISTENING AIR. Frank W. Masek, Cleveland, Ohio.

1,228,914. APPARATUS FOR RAISING SUNKEN SHIPS. Eugene S. Hayford, New Orleans, La.

1. An apparatus for raising sunken ships, including a collapsible and inflatable envelop, means

for supplying air thereto, and an auxiliary inflatable envelop mounted therein and constituting a buoyant support for the main envelop.

1,228,931. VENTILATING APPARATUS. Jason E. Kirk, Christiansburg, Va.

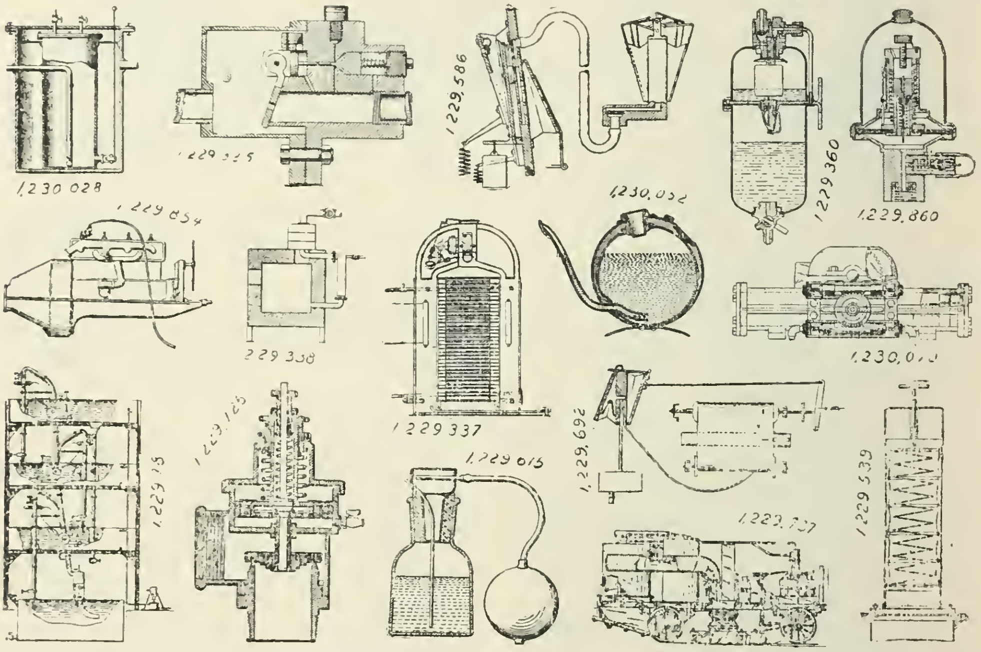
1,228,985. MEANS FOR PREVENTING EXPLOSIONS IN MINES. Audley Hart Stow, Maybeury, W. Va.

1. A method of preventing explosions in mines comprising saturating the air for the intake of the mine with watery moisture to produce, when such air reaches the cooler spaces of the mine, a condition of fog by moisture deposition around the bituminous dust particles causing them to adhere together and to the walls of the mine spaces.

1,228,989. DRY-KILN FOR DRYING LUMBER AND OTHER MOISTURE-BEARING SUBSTANCES. Harry Donald Tiemann, Madison, Wis.

1,229,039. AUTOMATIC TIRE-PUMP. Leslie Fred Crane, Lansing, Mich.

1,229,151. AUTOMATIC TRAIN-STOP. Hiram Gee Sedgwick, Mill Valley, Cal.



PNEUMATIC PATENTS JUNE 12

In an automatic train stop, a brake controlling means on the locomotive, a pneumatic motor for operating the same and means for connecting the motor to a storage reservoir, means for governing the supply to the motor to cause the same to operate and apply the brakes, means for restoring the motor to operative position, these means embodying a cut off automatically opened and closed by the action of the motor.

JUNE 12

1,229,276. THROTTLE-VALVE FOR PNEUMATIC TOOLS. Francis A. Jimerson, Athens, Pa.

1,229,325. SAFETY-VALVE FOR AIR-BRAKES. Michael H. Ryan, San Bernardino, Cal.

1,229,338. METHOD OF PRODUCING FUEL-GAS. Max Sklovsky, Moline, Ill.

1. The method of producing a gaseous fuel for heating furnaces, which consists in preheating air to a temperature high enough to substantially wholly vaporize fuel oil, passing the air so heated through a vaporizing chamber at high velocity, and introducing fuel oil into the stream of air flowing continuously through said vaporizing chamber, whereby the oil will be vaporized and thoroughly mixed with the heated air, and combustion in the vaporizing chamber will be prevented.

1,229,344. PNEUMATIC SPRAYER. Howard L. Stevens, Everett, Wash.

1,229,360. VACUUM FEED SYSTEM. Frederick Weinberg, Detroit, Mich.

1,229,397. PROCESS AND APPARATUS FOR DRYING EDIBLE PASTES. Albert M. Austin, Piermont, N. Y.

1,229,434. SILENCER. James Flockhart, Denver, Colo.

1,229,467. CARTRIDGE-LOADING MACHINE. Clarence Eugene Jack, Louviers, Colo.

1. In a cartridge loading machine, tamping means, a cross-head adapted to carry the same, head and the tamping means when the tamping and means for avoiding friction between the cross-means has been thrown out of operation, comprising compressed air operated connections between the cross-head and the tamping means.

1,229,501. PNEUMATIC PLAYER-ACTION. Frank E. Nichols, Mount Carmel, and Earl W. Feltis, Norwood, Ohio.

1,229,539. BLOWER FOR CLEANING FURNACE-FLUES. Walter P. Sparboom, Rochester, N. Y.

1,229,543. SYSTEM AND APPARATUS FOR CONTROLLING FLUID-MOTORS. Norman W. Storer, Pittsburgh, and Arthur J. Hall, Wilkinsburg, Pa.

1,229,586. AIR-MOTOR-GOVERNING DEVICE. Melville Clark, Chicago, Ill.

1,229,587. INSTRUMENT FOR RECORDING PERCENTAGE VOLUMES OF CONSTITUENT GASES. Walter William Crosweller, Crumpsall, Manchester, England.

1,229,615. ATOMIZER. James J. Holland, Philadelphia, Pa.

1,229,692. PNEUMATIC NOTE-SHEET-TRACKING DEVICE. Frank C. White, Meriden, Conn.

1,229,713. MECHANICAL AIR-BORNE SHIP. George Albert Chaddock, Broad Green, Liverpool, England.

1,229,726. SAFETY AIR-RELIEF VALVE. Frederick William Ebeling, Hoboken, N. J.

1,229,737-8. PNEUMATIC STREET-CLEANER. Robert W. Furnas, Indianapolis, Ind.; Frank A. Hamilton and Lelia F. Hamilton executors of said Robert W. Furnas, deceased.

1,229,781. LIQUID - ELEVATING APPARATUS. Eugene O'Sullivan, South Bethlehem, Pa.

1,229,792. AUTOMATIC CONTROL MEANS FOR AIR-PRESSURE PUMPS. Harvey J. Russell, North Bend, Oreg.

1,229,854. TIRE-PUMP. John W. Aker, Lancaster, Ky.

1,229,860. AIR-VALVE. Hervey Bowes Ashelman and John Sandford Johnson, Fargo, N. D.

1,230,028. PNEUMATIC PUMP. Edward E. Rardon, Hamilton, Kans.

1,230,052. VISCOUS-FLUID APPLIER. Lemuel Lester Stevenson, Emporia, Kans.

1,230,070. MOTOR FOR FLUID-PRESSURE DOOR-OPERATING DEVICES. Albert Gottschalk, New York, N. Y.

1,230,277. PNEUMATIC BRAKE. Francois Jules Chapsal, Paris, and Alfred Louis Emile Saillot, LaGarenne-Colombes, France.

1,230,282. DRYING APPARATUS. Charles H. Currier, Newark, N. J.

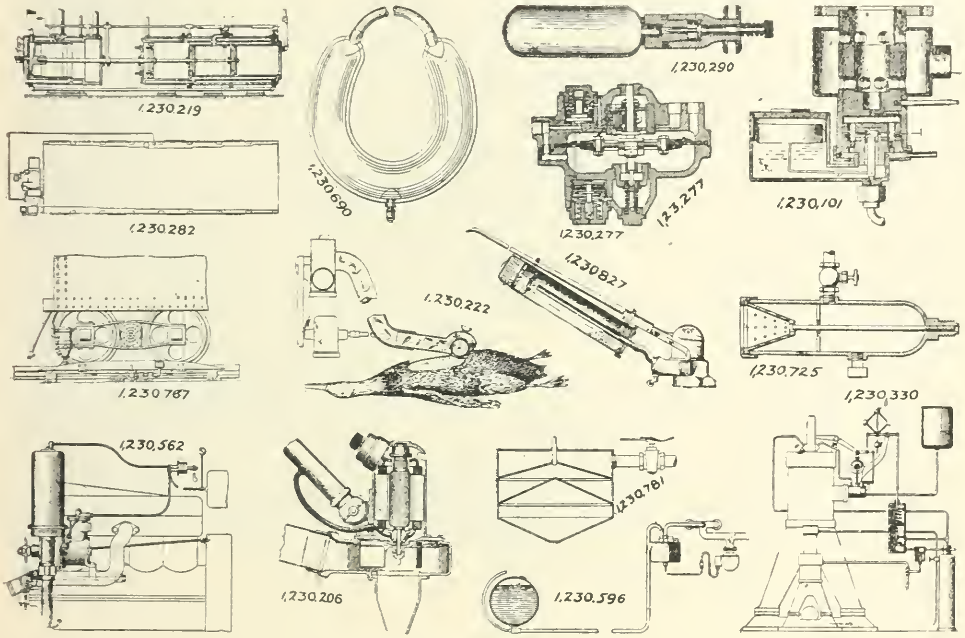
1. In apparatus of the class described, a kiln, inlet and outlet air ducts therefor located on opposite sides thereof, both sets of ducts opening downwardly toward the floor of the kiln, and means for supplying conditioned air under pressure to the inlet ducts.

1,230,290. LIFE-PRESERVER. Bertha A. Geiger, Chicago, Ill.

1,230,330. AIR-SUPPLY SYSTEM FOR COMBUSTION-ENGINES. Robert Schlaepfer, Winterthur, Switzerland.

1,230,549. PNEUMATIC ACTION FOR PLAYER-PIANO MECHANISM. Aura E. Whitehead, Chicago, Ill.

1,230,562. COMPRESSED-AIR STARTER FOR INTERNAL-COMBUSTION ENGINES. Niels Anton Christensen, Milwaukee, Wis.



PNEUMATIC PATENTS JUNE 19

1,230,071. PNEUMATIC-TIRE-ALARM DEVICE. Lewis E. Hawk, Chicago, Ill.

1,230,083. ELECTROPNEUMATIC VALVE FOR AIR-BRAKES. Thomas W. Scott, Baltimore, Md.

JUNE 19

1,230,101. PROCESS OF CARBURETING AIR. Turner D. Bottome, Indianapolis, Ind.

1,230,206. SUCTION-PRODUCER. Henry C. Niemeyer, Racine, Wis.

1,230,219. AIR-COMPRESSOR AND MOTOR. Arthur Reall, Philadelphia, Pa.

1. In an apparatus of the character described, the combination of a plurality of cylinders, pistons in said cylinders, means for driving the said pistons in one direction to compress air in one or more of said cylinders, means for conducting a portion of the air so compressed to a point outside of said cylinders, and means whereby a portion of the compressed air is permitted to act upon one or more of said pistons to drive the same in the opposite direction.

1,230,222. FEATHER-PICKING MACHINE. Otto G. Rieske, Toronto, Ontario, Canada.

1,230,596. LIQUID-FEED SYSTEM. Charles L. Stokes, Los Angeles, Cal.

1,230,690. PNEUMATIC CUSHION. Anton C. Eggers, Brooklyn, N. Y.

1,230,725. OIL-BURNER. Jacob F. Kraus, Pittsburgh, Pa.

1,230,767. AIR-BRAKE STOP. Eskil V. Palmquist, Hallandale, and Henry G. Lundquist, Seminole county, Fla.

1,230,781. AIR-FEED FOR MOTORS. Samuel E. Reid, Tahoka, Tex.

1,230,802. PNEUMATIC HAMMER. Frank J. Schroeder, Altoona, Pa.

1,230,827. VACUUM CLEANING APPARATUS. John J. Duffie, San Francisco, Cal.

1,230,832. VACUUM LIQUID - FEEDING APPARATUS AND METHOD THEREFOR. Charles Lawrence Stokes, Millong, via Young, New South Wales, Australia.

JUNE 26

1,230,834. MECHANISM FOR UNLOADING COMPRESSORS FOR STARTING. Burton S. Aikman, Milwaukee, Wis.

1,230,843. FOWL-DISINFECTANT APPARATUS. David B. Bird, Chicago, Ill.

1. A lever, resilient means supporting the lever in pre-determined initial position, a perch on the lever, a spraying device adjacent the perch for action upon a fowl when on the perch, a blowing device constructed to be actuated by said lever, duct connections between the blowing device and the spraying device, and operative connections between said lever and the blowing device, whereby the weight of a fowl on the lever will operate the blower for the purposes described.

1,230,858. APPARATUS FOR INFLATING LIFE-PRESERVING BELTS. William Gould Brokaw, Paris, France.

1. In apparatus for inflating life-preserving belts, a gas cartridge, a holder for said cartridge secured to the wall of an inflatable life belt, a gas release valve carried by said holder, a diaphragm fixed to said holder, a pin on the inner side of said diaphragm adapted to actuate said valve, a plate at the outer side of said diaphragm, a fulcrum for said plate fixed to said holder, an operating lever mounted in said holder adopted to turn said plate about said fulcrum in a direction to move said diaphragm inwardly and operate said valve.

1,230,925. MECHANISM FOR UNLOADING COMPRESSORS FOR STARTING. Walter J. Richards, Milwaukee, Wis.

1,230,949. VARIABLE-LOAD BRAKE. Walter V. Turner, Edgewood, Pa., and Edward H. Dewson, New York, N. Y.

1,230,951-2. FLUID - PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,230,953. RELEASE-VALVE FOR VACUUM-BRAKES. Walter V. Turner, Wilkinsburg, Pa.

1,230,995. AIR-MOTOR. Melville Clark, Chicago, Ill.

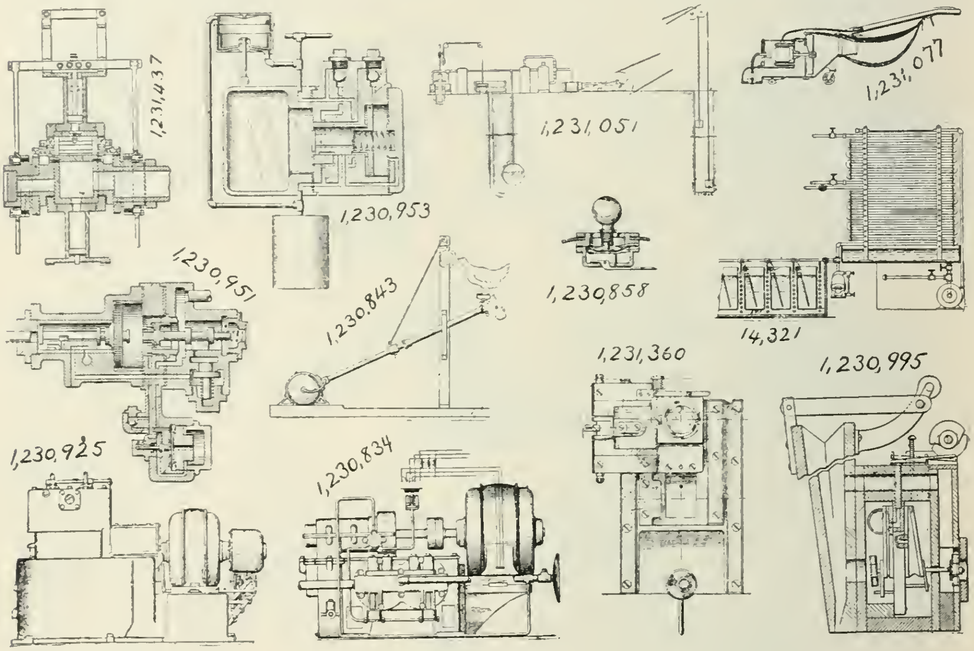
1,231,051. COMPRESSED-AIR POWER SYSTEM. Bruno V. Nordberg, Milwaukee, Wis.

1. In a compressed air power system the combination with a compressed air engine of an air compressor, an air receiver connected with the discharge of the compressor and having a manually controlled connection with the engine, and an open water tank located above and having a constantly open and unobstructed connection with the air receiver, said receiver and tank being so constructed, arranged and connected that a quantity of compressed air equal to the entire volume of the receiver may be drawn therefrom at an approximately constant pressure.

1,231,077. VACUUM-CLEANER. Ira L. Sheffler, Detroit, Mich.

1,231,081-2. AIR-BRAKE SYSTEM. Jacob Rush Snyder, Pittsburgh, Pa.

1,231,212. ELECTROPNEUMATIC ORGAN. Fredrick W. Smith, North Tonowanda, N. Y.



Pneumatic Patents June 26

1,231,214. TRIPLE VALVE. Jacob Rush Snyder, Pittsburgh, Pa.

1,231,360. PNEUMATIC FILM-CONTROLLING DEVICE. Albert S. Howell, Chicago, Ill.

1. In apparatus for moving film, an aperture element, a passage through which the film is adapted to travel past said aperture, and means for exerting pneumatic pressure upon the film during transit through said passage.

1,231,437. ROTARY ELASTIC-FLUID ENGINE. William Herbert Seddon, Painswick, England.

1,231,515. DRY-PIPE VALVE. Poul Flamand, Philadelphia, Pa.

14,321. PROCESS OF AGITATING WATER IN MAKING ICE. Willis B. Kirkpatrick, Baltimore, Md.

1. A process of agitating water by air in the manufacture of ice which consists in providing a supply of de-hydrated air at a pressure of from twelve to twenty-five pounds above atmosphere, passing said air through a conduit within the mass of water to be frozen, reducing the pressure of the air before it is released to a point slightly in excess of that of the atmosphere, and delivering said air into the water near the bottom of the mass.

COMPRESSED AIR MAGAZINE
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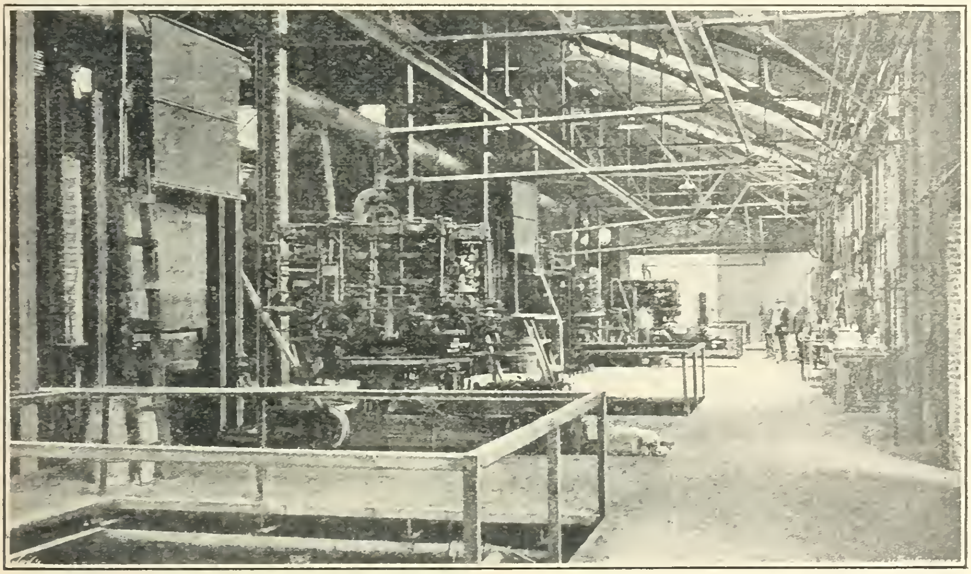

FIG. I. BOTTLE FACTORY SHOWING THREE MACHINES

A MILK BOTTLE FACTORY

It is somewhat remarkable that comparatively so little is known either by the general public or by mechanics and engineers as a class of the practical details of an industry of such far reaching importance as that of glass manufacture. We cannot think of any line of production in which so much specialized ingenuity has been concentrated, and we may say with probable certainty that there is no other line so indebted to the constant services of compressed air for its successful operation.

The present article has to do with a single establishment, and that only one of three, devoted exclusively to the production of a single article, a milk bottle. The plant spoken of is that of the Thatcher Manufacturing Company, Elmira, N. Y., the other two plants spoken of being located at Kane, Pa., and Streator, Illinois. The description which follows, with also the illustrations, is reproduced, with more or less abridgement, from *The Engineer,* London.

In the design and arrangement of the buildings and apparatus, the routine of operations has been carefully planned and provided for, but we here confine our attention to the actual production of the glass and its manipulation—but without hands—to the final delivery of the completed bottle. The raw material, consisting of silica, sand, soda-ash, lime, etc., are delivered from a railroad siding and transferred by conveyors to large storage bins. The materials are taken from the bottom of these bins and elevated to the mixing room on the top floor of the building, from which the progress is downwards to the furnaces.

The method of obtaining the correct mixture is a matter of experiment, and is worked out to suit each particular case. Once determined the correct proportions are maintained automatically. From the mixing room the material is delivered to the furnaces, together with a small amount of cullet (glass scrap). The furnaces are arranged on the floor of the main building. They are built of heat-resisting bricks, and are oblong in shape, being about 7 ft. high and 16 ft. wide. They are divided into a melting pot, refiner, and working pot, the raw material being fed into the melting pot at one end, and after flowing through the refiner, the molten glass is taken through an opening from the working pot at the other end. Producer gas is used in the furnaces. It is of low calorific value, ranging between 140 to 150 B.Th.U. per cubic foot. There are no by-products from the producers. The gas is led through flues to a "butterfly" valve, by means of which it can be directed to a set of burners on either side of the furnace. A similar valve controls the air supply. Root positive pressure blowers are used to furnish the air.

The burnt gases leave the furnace on the side opposite to the burners, passing out through the air supply ports into a regenerator, a large chamber filled with bricks. The burnt gases give up heat to these bricks—which reach a cherry red—and when the flow of air and gas is reversed by means of the "butterfly" valve, this heat is given up to the incoming air before it is mixed with the gas; this, of course, results in a considerable saving. The flow of air and gas is reversed every half hour. The furnaces, owing to the high temperature employed in them, which reaches 2,600 deg. Fah., are comparatively short-lived, the average life of a furnace being 12 to 15 months, and the maximum about 30 months. The working pot, from which the molten glass is taken by the machines, is circular in shape, and is kept constantly revolving, so that a fresh supply of molten glass is continually presented to the machine. These working pots are really a part of the bottle-making machine. They are kept operating continuously as long as the furnace is in service.

The bottle machines are of the Kent-Owen six-arm type. At the time this article was written there were four installed, while two further machines, each with ten arms were in process of erection, and will, by now, possibly be in operation. All these machines represent the latest development in bottle-making machinery. They are *entirely automatic* in operation, and require the services of but one attendant for regulating the speed, inspecting the bottles, and oiling the machine. Fig. 2 shows one of the bottle machines in operation while Fig. 1 gives a general view of the operating floor, showing three bottle machines, the first being run back on its track to give a good view of the working pot.

The entire machine, together with its electrical driving motor, is mounted on a four-wheeled truck, running on rails, so that it can be backed away from the furnace. There are three systems of air piping connected to the machine, one carrying a vacuum of 27 in., to draw the glass into a measuring or gathering mould; one carrying air at 25 lb. per square inch pressure to blow the glass into the forming mould, and one for low pressure air to cool the machine. These pipes can be seen in Fig. 1, the high pressure and vacuum lines on the right, connected to the bottle machines through flexible couplings, and the large low-pressure pipe on the left. The machine as a whole revolves on a central trunnion. That illustrated is known as a six-arm machine—that is, it has six arms, each arm carrying two sets of moulds, a gathering and a forming mould, and it is consequently capable of turning out six bottles for every revolution. The operations are controlled entirely by a set of stationary cams. The main cam raises and lowers the entire machine six times in every revolution. The operation is so timed that each arm, with its gathering mould, dips into the working pot, and, at the same time, is connected to the vacuum line, and a supply of molten glass drawn in. As the machine rises a knife passes under the mould and cuts off the glass. A quarter of a revolution further on the measuring mould folds back, leaving an accurately measured pencil of glass hanging from the end of the arm, as is plainly shown in Fig. 2. Meanwhile, the forming or finishing mould has deposited a finished bottle in the runway, which is also shown in that engraving, and is raised up to the level of the arm, so that it may close around the glass. The air valve then automatically opens, and the glass is blown to the exact shape of the mould. The arm carrying the completed

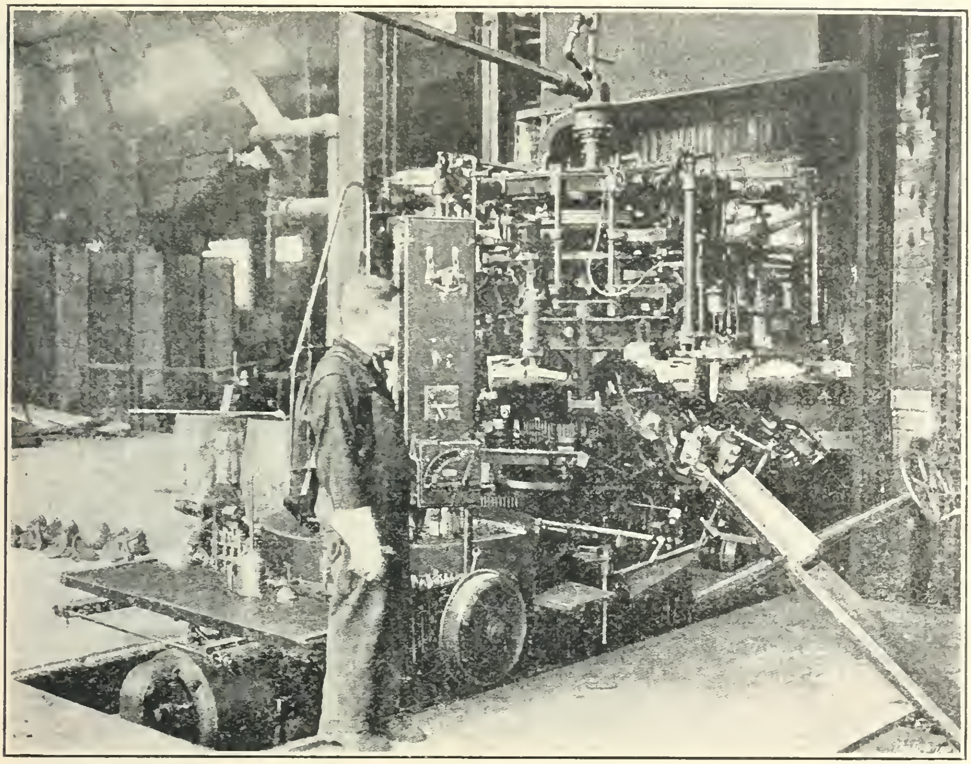

FIG. 2. BOTTLE MACHINE IN OPERATION

bottles is swung down out of the way, the measuring mould again closes ready to receive a fresh supply of glass, and the operation is repeated. With a six-arm machine the above operations are performed six times in every revolution—once for each arm—and, when making one-quart bottles the machine turns out from 12 to 14 per minute.

The bottles are made so rapidly that it is necessary to cool the moulds by blower air to prevent overheating. As the speed of the machine and the heat of the moulds can be regulated to a nicety, a more perfect bottle can be made than would otherwise be possible.

The bottles, on arriving at the end of the runway, while still red hot, are placed in a lehr or annealing furnace, one of which is seen in Fig. 3. These lehrs are 80 ft. long and are equipped every 8 ft. with pyrometers and dampers for regulating the heat. The temperature at the entrance to the lehr is 1,100 deg. Fahr. This is gradually reduced to 90 deg. at the other end. The bottles are placed on an endless travelling grate, which extends across the full width of the lehr. It takes eight hours to reach the end of the lehr, and the bottles are then removed and packed ready for shipment.

The plant is operated by electricity derived from the city mains. An electrically-driven air compressor and vacuum pump of the Ingersoll-Rand Company's "Imperial" type supplies the bottle machine. This compressor is of the duplex "single-unit" type, with cylinders 18 in. in diameter by 14 in. stroke, and is driven by a 75 horse-power General Electric 60-cycle induction motor, through a short belt drive and adjustable idler pulley. The normal speed of the motor is 900 revolutions per minute, and that of the compressor 150 revolutions per minute, which gives a piston displacement for each cylinder of 656 cubic feet per minute. This is sufficient to operate the four six-arm machines now in use, while two new combination vacuum and pressure machines are being installed to work the two new ten-arm bottle machines. The vacuum pump requires no regulation, but the air compressor, being run at constant speed, is provided with an unloader on the intake pipe, which serves to cut off all air from the com-

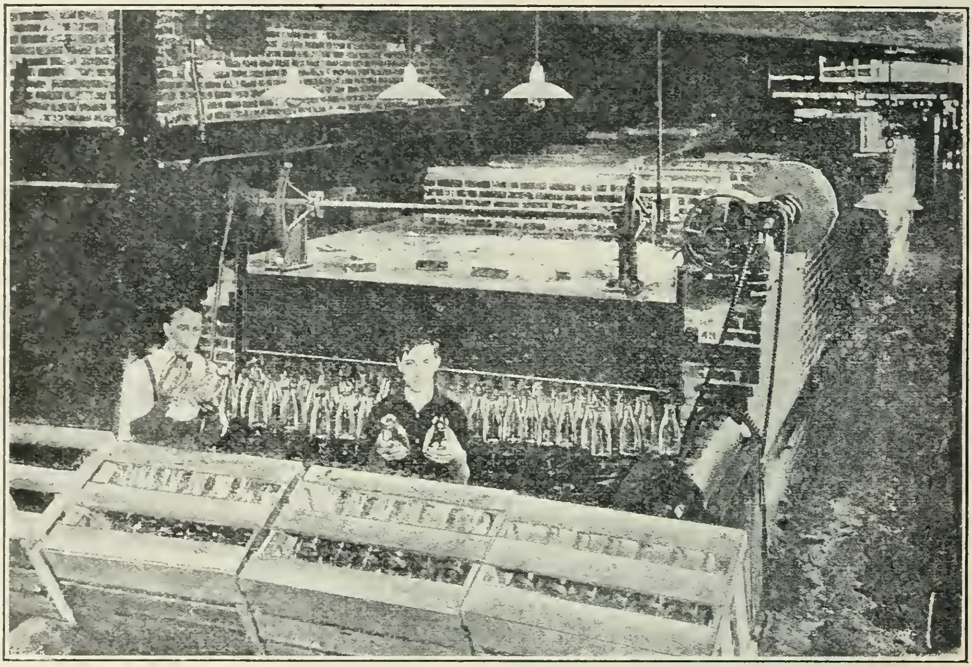

FIG. 3. ANNEALING FURNACE

pressor during unloaded periods. When only two of the three six-arm bottle machines were in actual operation, the compressor was observed to be unloading for a period of about five seconds, every fifteen seconds, as indicated on the chart of a Bristol recording instrument.

The compressor has been operating constantly for a period of three years, carrying the full load of the plant, and is only shut down once a week long enough to remove the outlet valves for cleaning off carbon deposit. This has been the only source of trouble in the machine during that period, and it is due to the great heat of compression. The oil used for the lubrication of both the compressor and vacuum pump is of very high grade, so as to reduce this trouble to a minimum, but a not inconsiderable amount of oil is drawn into the vacuum pump from the bottle machine, which has to be lubricated very copiously with a heavy, low-grade oil on those moving parts which are subject to intense heat. As large a proportion as possible of this oil is removed in a Cochrane oil separator, but it is found impossible to remove it all, and a small amount is drawn into the vacuum pump and finds its way on to the discharge valves.

We are indebted to Mr. R. W. Niven, of the Thatcher Manufacturing Company, for assistance in gathering the data contained in this article.

COMPRESSED AIR FOR ACCELERATING SEWAGE

The city of Bradford, Yorkshire, England, has a main sewer which has furnished a problem of its own for which a complete solution has been found. The sewer is 36 inches in diameter and five miles long with a drop of 70 feet in the distance. The grade of the sewer is not uniform, however, but undulates up and down, in one place curving under a canal, and as the sewage is loaded with heavy solid matter it was found impossible to maintain the flow.

Pumping of course would have been costly and was to be avoided if possible, and it has been found that by using compressed air at a pressure of 80 lb. and discharging it at regular intervals into the sewer, thus forming pistons of air, the full flow of the sewer is maintained with no sign of obstruction. This practice has been followed long enough to demonstrate its complete success, and there is no trouble of any kind.

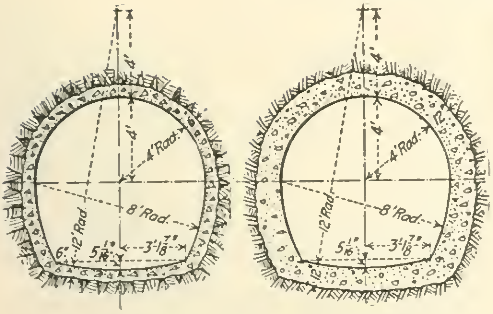

FIG. 1

A TUNNEL DRIVING RECORD AND SOME COMPARISONS

BY H. DEVEREUX*

The Pine Mountain Tunnel which is being driven in Marin county, California, is for the Marin Municipal Water System. It is of horseshoe section, 8 by 8 ft., net, inside the concrete lining. The total length is 8,700 ft., of which about 600 ft. near the two portals will have a 12-in. concrete lining, and the remaining 8,100 ft. 6-in. lining, the two sections being shown in Fig. 1.

The quantities per lineal foot are as follows: Excavations, 3 cu. yd., theoretical amount of concrete in 12-in. lining, 1.2 cu. yd.; concrete in 6-in. lining, 0.6 cu. yd. The actual quantities of concrete will be about 35 per cent. greater, on account of overbreakage. The work is being done under the direction of M. M. O'Shaughnessy, consulting engineer for the district, A. R. Baker, engineer for the district, and C. T. Broughton, resident engineer on the work. The contract was awarded early in December, 1916, to Mc Leran & Peterson, of San Francisco, at $257,400 for the entire work, or $29.70 per lin. ft. for driving and lining the tunnel. Work was commenced in the middle of December. Hand-drills were used until about February 1, machine-drills since that time. The actual cost of driving has been about the same for both methods, but the machine work is much more rapid. Up to May 15 about 2,000 ft. of progress was made on the east end, and 1,000 ft. on the west end. Concreting commenced about June 1. The maximum progress in driving for any one month has been 568 ft. in the east heading, or 19 ft. per day. The average progress since the machine drills were installed has been 13 ft. per day in the east end, and 10 ft. in the west end.

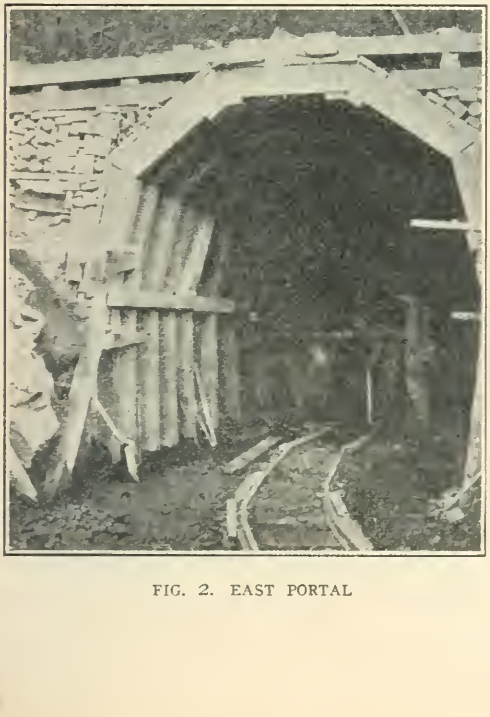

FIG. 2. EAST PORTAL

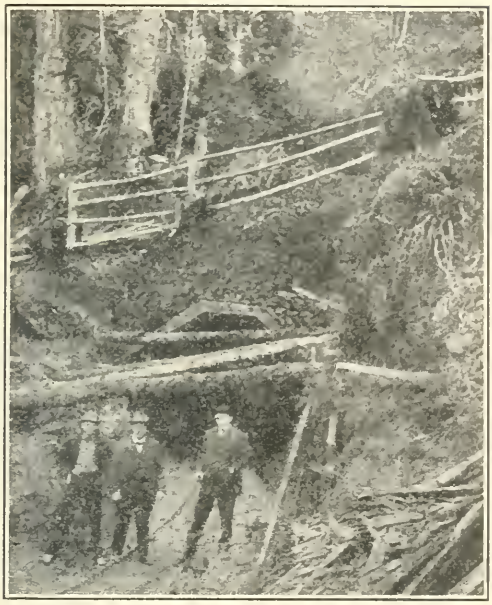

FIG. 3. WEST PORTAL

SOME AMERICAN TUNNEL RECORDS

Some other American tunnel records are as follows:

On the Sheep Creek tunnel in greenstone

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*Condensed from *Western Engineering.*

and slate the maximum progress was 661 ft. per month and the average for a period of six months, 596 ft. per month. At the Alaska-Gastineau mine, an 8 by 10-ft. tunnel was driven 8,800 ft. at a rate of 544 ft. per month. The maximum monthly progress in the Roosevelt tunnel, which had a 6 by 10-ft. section and was driven in Pikes Peak granite, was 435 ft., and the average was 292 ft. The Elizabeth Lake tunnel on the Los Angeles Aqueduct was driven 604 ft. in one month through black shale. The section was 12 by 13 ft. The Red Rock tunnel, also on the Aqueduct was driven 1,061 ft. in one month through cemented sandstone. An 8 by 8-ft.tunnel for the Arizona Copper Co. was driven 799 ft. in one month through porphyry. The average monthly progress was 669 ft. The Gunnison tunnel, 6 by 10½ ft, was driven 824 ft. in one month through soft limestone. The Mt. Royal tunnel, 8 by 12 ft. was driven 810 ft. in one month through limestone. An 8½ by 9½-ft. tunnel at Mammoth, California, was driven 395 ft. in one month. The average progress was 316 ft. The Laramie-Poudre tunnel, 7½ by 9½ ft., was driven 653 ft. in one month through granite. The average was 525 feet.

The power-plant for the Pine Mountain tunnel is on the Bolinas road about three miles west of Fairfax. The east portal is about 1,000 ft. from the power-house. The west portal is nearly two miles southwest from the power-plant. Until recently the west portal could be reached only by pack-train, but the trail has recently been improved so that light loads can be hauled over the mountain.

The compressor-plant consists of three 25-hp. Fairbanks-Morse Y-type semi-diesel engines, and three 8 by 8-in. Sullivan compressors.

TUNNEL AIR PRESSURES

The pressure maintained at the compressor is 100 lb. per sq. in. A study of records on 25 other long tunnels shows that this is the average pressure maintained. The lowest was 85 lb., on the Strawberry tunnel, and the highest, 120 lb. on the Laramie-Poudre. Six tunnels used 100 pounds.

Air is conveyed through a 3½-in. pipe 1,000 ft. to the east portal and 10,000 ft. to the west portal. Three hundred cubic feet of free air per minute is supplied, which is sufficient to run three drills and also the forges. The loss of pressure at the west end does not exceed 2 lb., which shows the advantage of having pipes of sufficient capacity. Records on nine long tunnels show capacities of air plant ranging from 247 to 868 cu. ft. of free air per minute, with an average of 550 cu. ft.

Three No. 18 Leyner drills with a 1¼-in. chuck, 24-in feed, and six sets of 1¼-in. hollow steel from 24 to 96-in. long were used. There is an 18 gal. motor tank and an air line manifold. The drills are mounted on horizontal bars. Jackhamers are used for trimming. On other long tunnels preference was about equally divided between vertical columns and horizontal bars.

The duty of a No. 18 Leyner drill in this tunnel is 5 ft. of hole per hour, using 1,000 cu. ft. of free air at 100 lb. pressure per lin. ft. of hole drilled. The cost of drilling including bonus, is $0.20 per ft. This estimate allows for delays.

POWER COSTS

The cost of fuel and lubricating oil for a 135 day run was as follows: 11,000 gal. fuel oil, 24 Baumé gravity, at $0.032 per gal. = $352; 250 gal. valvoline, strained and used twice, at $1.35 = $324; hauling three miles from railroad, at $0.005 per gal. = $55; total, $731.

The plant was run continuously and 62½ hp. was developed. This gives a cost of $0.36 per hp. hour for fuel and lubricating oil, the power being sufficient for three drills and two forges. The cost of labor at the power house is $320 per month. During March the total progress in both headings was 854 ft. and the cost for power was $0.65, of which $0.29 was for fuel and $0.36 for labor.

A 25 hp. Fairbanks Morse Y type engine has since been installed to operate a 220 volt, 25 kilowatt generator which will be used to run a lightning plant and a rock crusher.

COSTS OF ELECTRIC POWER

Purchased electric power on four other long tunnels cost from $1.65 to $2.15 per lin. ft., or an average of $1.90. Electric power generated on the work for the Elizabeth Lake tunnel on the Los Angeles Aqueduct, cost $5.25 per ft., and on the Strawberry tunnel, where it was transmitted 23 miles, $5.50 per ft. On another tunnel where steam was used with wood for fuel, the cost for power was $2.50 per ft. Where steam was used with crude oil for fuel the cost was $2.28 for fuel and $0.80 for labor.

VENTILATION

For ventilation 1,000 ft. of 10 in. pipe has been laid at each heading, reducing to 8 in. for the remainder of the distance. This pipe has been found to be too small, and is to be replaced with a 12 in. pipe, using a blower working at a pressure of 4.5 lb. To clear a tunnel of foul air in 15 minutes, which is the maximum time that should be allowed for delays after blasting, requires a capacity of 4,000 cu. ft. of air per minute. An accepted rule is to allow 75 cu. ft. of air per man per minute, and 150 cu. ft. per animal. The average rated capacity of ventilating apparatus used on 16 long tunnels was 3,400 cu. ft. per minute. The size of the ventilating pipe ranged from 10 in. for the Carter and Mission tunnels to 18 in. for the Elizabeth Lake and 19 in. for the Central tunnel. Where light gage sheet metal pipes are used for ventilating, it is advisable to build a small bulkhead of track ties in front of the pipe before blasting in order to prevent collapse of the pipe.

ILLUMINATION

For lighting, acetylene lamps on the men's caps or candles have been used, but, as already noted, an electric lighting plant has now been installed. Acetylene lamps have been used on several long tunnels, small lamps on the men's caps and larger stationary lights placed 150 ft. apart along the tunnel. This is an economical method of lighting. When electric hauling is done electric lights are usually employed. In wet tunnels electric lights are uncertain. The cost of lighting the Mile Rock tunnel with electricity was $0.50 per ft. of tunnel.

THE ROCK AND THE DRILL HOLES

The rock so far encountered in the east end of the tunnel is sedimentary with intrusive igneous rock. On the west end there is Franciscan sandstone, black serpentine, and hard boulders, with some diabase. The rock at the west end is harder than at the east end.

The number of holes per round at the east end is 9 to 14, and 14 to 16 at the west end. Six feet of hole is drilled per round, the wedge-cut system of arrangement being used. Forty per cent. L. F. gelatine powder is used, supplied by the Hercules Powder Company. In the east end, 9 lb. of powder, 19 ft. of fuse, and 4 caps are used per lin. ft. of progress. In the west end, 15 lb. of powder, 26 ft. of fuse and 4 caps are required.

Records of other long tunnels show that the wedge-cut was used in 19 instances, the pyramid-cut in 4, and the bottom cut in 7. An analysis of the depth of holes generally used in American practice, would lead one to in-

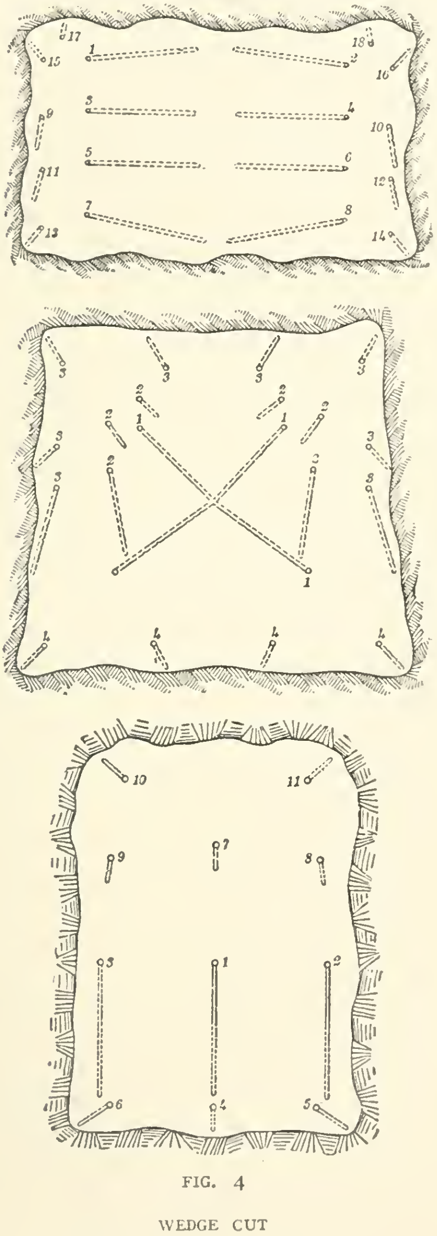


FIG. 4

WEDGE CUT

PYRAMID CUT

BOTTOM CUT

fer that the most successful driving was secured when the average depth of the holes was from 60 to 80 per cent. of the width of the heading for wedge and pyramid cuts, and 60 to 80 per cent. of the height for the bottom cut. In cases where deeper holes had been used, and the depth of holes was later reduced according to the above rule, there was an increase of speed of as much as 20 per cent. and a decrease of powder used of as much as 25 per cent. The number of holes per round is dependent upon the character of the rock. An approximate rule for sedimentary formation is one hole to 5 to 6 sq. ft. of face of heading, and in igneous formations, one hole to 2.5 to 4 sq. ft. of face.

EXPLOSIVES

The amount of explosive used in small tunnels ranges from 3.5 to 10 lb. per cu. yd. of material removed. Bottom-cut holes appear to require more powder than pramid or wedge-cut holes. As regards percentage of gelatine powder used, practice has ranged from 40 per cent. in six tunnels to 100 per cent. in the Roosevelt tunnel, which was driven through Pikes Peak granite. Loading the bottom of the hole with 80 to 100 per cent. powder and the rest with 40 to 60 per cent. has given good results in a number of cases. On the Grapevine division of the Los Angeles Aqueduct 40 and 60 per cent. ammonia powder was used. There was comparatively little difference in the effect of the two grades. Ammonia powders are affected by moisture and are not suited to wet tunnels. The gases from the ammonia are disliked by the workmen.

It is best to place the cap near the top of the charge and tamped with powder, although many powder-men prefer placing the cap at the bottom of the hole. A cap has recently been placed on the market that acts like a time-fuse, enabling the cut-holes, relievers, back-holes, and lifters to be fired at intervals and in rotation by an electric battery.

On the east end there are two drillers and one helper per shift, and one driller and one helper per shift on the west end. Three shifts are worked and as many as five rounds or 30 ft. of progress has been made in 24 hours, requiring 150 ft. of drill-hole per drill for each 24 hours. Four shovelers are employed on a shift in each end, two working at any one time and two resting. They handle from 10 to 15 cu. yd. per man per shift. The shovelers use square-pointed shovels, and shovel from steel floor-plates, ¼ in. by 4 by 6 feet.

The material is transported by mules in turn-table end-dump cars of 25 cu. ft. capacity. When the work has progressed so far that mules cannot handle the material economically, it is proposed to remodel White or Stanley steam-automobiles to do the hauling. Such remodeled machines are now being used successfully on the Twin Peaks tunnel.

WATER IN TUNNEL

Considerable trouble has been experienced at the west end of the Pine Mountain tunnel on account of water. There are "pockets" of water that give a large flow for a few days and then run dry, making pumping a difficult matter. This has been remedied by cutting a ditch to drain the water back from the face of the tunnel. This matter of drainage is frequently a considerable item of expense in long tunnels. The cost of pumping at the Mile Rock tunnel was $1.30 per lin. ft. At the east end of the Strawberry tunnel, the wet end, the cost of pumping was $1.36 per lin. ft. At the Roosevelt tunnel a drainage ditch 4 by 6 ft. was excavated at a cost of $1.10 per ft. If an 8 by 8-in. ditch is carried under the track in the middle of the heading, lined on the sides and covered with a 2-in. plank at an elevation of 18-in. below grade at the same time as the rest of the drilling is done, the water-problem at the lower end of a tunnel will be easily and economically handled. A similar arrangement is advisable at the upper end of the tunnel whenever the grade is such that the ditch need not be over 4 or 5 ft. deep at the portal.

TOO MUCH OF A HURRY

A favorite recommendation in selling a car is that it will pick up speed very rapidly; but it would seem that both dealers and manufacturers are working against their own interests in suggesting such methods of operation to users of cars. To accelerate a car weighing over a ton from five miles an hour to forty miles in fifteen or twenty seconds means a tremendous strain on every portion of the machine, with consequent rapid deterioration, and is especially destructive of tires. Moreover, there is no reasonable advantage in the procedure, for the time gained thereby could hardly be measured with a stop watch in a day's run. The result is attained by supplying a much greater power than the user has any need for, and the principal use made of it is to jump across the track in front of trolley cars and railroad trains. Once a year it might save a man's life, but even then it would not be necessary if ordinary precaution is observed in driving. In the meantime the car owner is paying for a lot of gasoline consumed by the excessively large engine, which has been of no benefit to him.—*Scientific American.*

OLD, OLD SOAP BUBBLES

Prof. J. Dewar, in a discourse recently delivered at the Royal Institution in London, explained how soap bubbles could be made to last for months, and exhibited several specimens. The first requisite is that the air used in blowing the bubble shall be free from dust. In Prof. Dewar's process the air is filtered through cotton wool, and the bubbles are blown by opening a stop-cock in the air-supply tube. For the soap solution he prefers the purest oleic acid (tested by the iodine number) and ammonium soap (not potassium or sodium). To make a bubble durable the sac of liquid must be removed from its bottom by suction through tubes applied from outside. The lecturer showed bubbles more than half a yard in diameter, blown in glass vessels containing pure air at atmospheric pressure. A little water is kept at the bottom of the vessels. A uniform temperature of about 50 degrees Fahr. is favorable to longevity. Some of Prof. Dewar's smaller bubbles were nearly a year old.—*Scientific American.*

BENEFICENT THIEVERY

Dr. Marques da Silva rented a house in a suburb of Rio Janeiro to a family of negroes. After remaining in the house long enough to run up a good-sized unpaid rent bill, the negroes suddenly decamped, taking with them all the electric wiring and plumbing fixtures in the house, and a lead pipe leading underground to a water-main. Dr. da Silva went through the looted house and sat down on the veranda to think over the iniquity of his missing tenants. Suddenly he noticed a peculiar metallic gleam in the trench where the pipe had been torn out. The gleam was caused by mercury oozing from the clay. The mercury mine probably will make the doctor a millionaire.

SCIENTIFIC GUARDIANSHIP OF COMPRESSED AIR WORKERS

BY EDWARD LEVY, M. D.

Physician to the New York Public Service Commission

The use of compressed air in subaqueous work has been common practice during the past 75 years, but, until recently, very little progress has been made in the elimination of compressed air illness among the workmen. This has been a serious deterrent to carrying on work of this character. The present day treatment of compressed air illness probably dates from the time when E. W. Moir, in 1890, introduced the medical lock for decompression, in connection with the construction of the first tunnels under the North River, which, after many mishaps, were completed in 1908.

The sinking of caissons for bridges and building foundations had always been attended with numerous cases of compressed air sickness, oftentimes fatal. The large tunneling projects in the United States and England offered the first general opportunities for the study of large numbers of men employed in this class of work. The period from 1902 to 1908 was marked with great activity in compressed air tunneling in New York City, by the construction of six tunnels under the North River and eight tunnels under the East River.

SOME IMPROVEMENT

While each succeeding large enterprise showed some slight improvement, the results were so far from being satisfactory that it was found necessary by the Department of Labor of the State of New York to formulate certain rules for the protection of the men employed in compressed air.

Probably the best record previous to 1914 was that made during the construction of the Pennsylvania tunnels under the East and North Rivers. The record on the Pennsylvania work was regarded as exceptional, there having been but 3,692 cases of "bends" reported, with only 20 deaths. The latter figure was thought an extremely small number of fatalities for this character of work. The results obtained were due to the great care exercised by those in charge who provided a staff of physicians assisted by nurses trained in the particular work of handling compressed air illness. While it was found that the results of the Pennsylvania work were much better than had previously been obtained, yet they were not considered satisfactory.

Realizing the unprecedented magnitude of the compressed air tunnel work which was about to be undertaken under the Dual System contracts, the Commission determined at the outset to obtain the best possible working conditions for the men employed in the tunnel headings. To this end, conferences were held with medical experts and the experience of the engineers themselves was utilized. It was recognized by those charged with the carrying out of this work that, in order to prevent as far as possible compressed air illness among the engineers and workmen, there must be enforced the most rigid requirements for the conduct of the work, particularly as to the selection of the men employed, the hours of labor, the methods of decompression and the facilities for the treatment of the men in case of compressed air sickness.

SPECIFICATIONS PREPARED

To this end, specifications were drawn up in accordance with the labor laws, with additional requirements to fit this particular work. It was provided in the specifications that the quarters for the workmen should be fully equipped with proper facilities for bathing, resting, drying the clothing, and for a supply of hot coffee at all times; that the hospital room have an attendant constantly in charge; that a medical lock with two compartments be furnished where the men could be subjected to treatment if attacked by compressed air illness; that this lock should contain cots, a telephone, an air gage; that there should be arrangements for the removal and hospital treatment of any employe who required it; that every person employed in compressed air should be subjected to a rigid medical examination, and employed only if found to be fit to engage in such work; that such employe should be subjected to re-examinations during the course of the work, in order to watch his physical condition, and that all parts of the tunnel should be kept in a thoroughly sanitary condition and free from refuse.

That the conditions attending decompression should be as nearly ideal as practicable, it was required that whenever the air pressure exceeded 22 pounds per square inch there should be an intermediate chamber, so that the men would be required to pass through two air locks; that each lock be provided with an air gage and a clock, so that a record could be kept of the decompression, and a lock tender must be on duty at all times to decompress the men as directed.

In addition, the question of air supply in the tunnel headings was specifically covered in that the contractor was required to cool the air so that the temperature should be moderate at all times; that the supply of fresh air should be sufficient to prevent the accumulation of carbon dioxide to a greater amount than one part in a thousand; and that adequate ventilation should be provided by means of vent pipes carried from each heading under pressure to the outside atmosphere.

SYMPTOMS OF DISEASE

There are several symptoms of compressed air sickness; one, the so-called "bends," another termed "chokes," and still another known as "staggers." In some cases paralysis, and in extremely severe cases collapse and death occur. The symptoms are due to the liberation of bubbles of nitrogen, which, taken up in solution by the fluids of the body while compression is under way, are liberated in various parts of the body when the men are decompressed too rapidly. The amount of gas taken up by the tissues during the compression period would naturally depend on the length of time the subject is under compression, and the pressure. The "bends," most frequent of the several symptoms of caisson disease, is marked by pain in the joints, generally extremely severe. If bubbles lodge in the blood vessels of the lungs a partial obstruction is caused, and the patient suffers from a form of the disease commonly termed "chokes." Vertigo, commonly known as "staggers," is most often caused by air bubbles in the brain, or in the middle ear. Collapse, followed by death, is caused by quantities of free air in the circulation.

The process of decompression consists in bringing the tunnel worker back to normal air pressure by way of the air locks. If this decompression takes place too quickly, symptoms frequently are manifested. The situation has been compared to the opening of a bottle of effervescent wine or water, when, if the cork is suddenly drawn, the bubbles of gas rise quickly to the surface and are liberated with great force. On the other hand, if the cork be drawn carefully, and the latent effervescence be permitted to escape slowly, the liquid will remain undisturbed.

A MEDICAL JOKE

In this connection, an amusing story related by Hill in his book "Caisson Sickness" is of interest. Certain commissioners who went to celebrate the completion of a tunnel took some highly carbonated ginger ale into the compressed air chamber. Owing to the compression, when the cork was drawn the liquid proved flat, and, thinking it bad, all except one refused to partake. The latter, being thirsty, drank half the bottle, which he then corked and put into his pocket. During decompression in the air lock the cork of the bottle blew out with a loud report, causing much excitement, one commissioner believing he had been shot. This was nothing compared with the disturbance caused within the anatomy of the commissioner who had partaken.

At this writing, the air pressure on the Whitehall-Montague street tunnel is 33 pounds while that on the Old Slip-Clark Street tunnel has been reduced to 17 pounds as the tunnel headings have met. Before the meeting of these headings, a maximum pressure of 37½ pounds was reached. The pressure on the 14th Street-eastern caissons which are being sunk in advance of tunneling has reached 39½ pounds, but, eventually, after tunneling has been started, the pressure will probably reach a maximum of 45 pounds. On the 60th Street tunnel work no pressure has been used as yet, but ultimately, it is expected that the pressure on this work may reach 50 pounds, the highest yet used in tunnel work in New York City.

EXPERIMENT SUCCESSFUL

Up to the time that the air pressure had reached 21 pounds, which is a relatively light pressure, the engineers and physicians in charge of the work were not in a position to determine whether the precautions which had been taken to minimize compressed air illness were to prove effectual. But, as the pressure was raised above this point, and no serious results followed, it became fairly certain that the new requirements would prove to be the solution of the problem. Up to the present time there have been more than 700,000 decompressions, and it is believed, from the results thus far obtained, that it is possible to work with safety under a pressure in pounds considerably in excess of the limit now fixed under the New York State labor laws, provided the working shifts and time and method of decompression are properly adjusted.

To date there have been recorded only 304 cases of "bends" during the construction of the new East River tunnels under the supervision of the Commission, over a period of two and a half years of compressed air tunneling. If this record be compared with the records handed down from some of the earlier tunnel projects in New York City, one of which shows 179 reported cases of "bends" in three weeks, it will appear that considerable progress has been made in the elimination of compressed air illness among the workmen. In comparing records of this character, it must be constantly borne in mind that the number of reported cases of "bends" is far below the actual, as the workman, unless he is in such physical pain that he must seek relief, attempts to keep his record clear and conceals his ailment, as repeated cases of "bends" would tend to show him unfit for the work, and might result in his being disqualified, especially under higher pressures. This record is a true record as far as can be obtained from a most careful supervision of the men upon their exit from the tunnel headings, and it is probable that there have been numerous slight attacks which have not been brought to the attention of those in charge. This, however, is no more true of this work than any other work of a similar character.

ONE FATAL CASE

Only one case of compressed air illness on this work has proved fatal, which, in itself, establishes a very remarkable record. In this one instance, the physicians and engineers are confident that the life of the workman undoubtedly could have been saved had he, immediately after leaving the compressed air lock, notified someone in authority that he was ill. His condition was not discovered until an hour and fifty minutes after he had left the lock. Emergency treatment applied at that time was not effective, owing to the destruction of tissue which had taken place during the intervening periods. Investigation of this case developed a question as to whether the man took the full time for decompression as prescribed by the regulations.

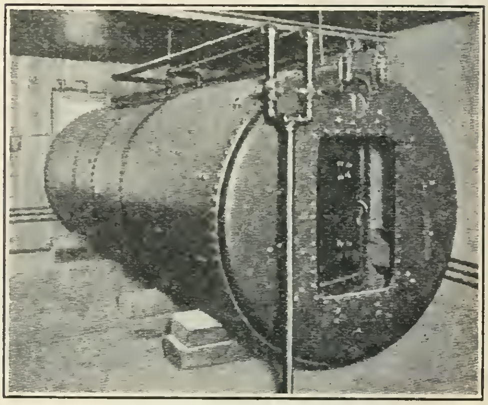
THE HOSPITAL LOCK

It has been customary, as in other recent work, to treat the man in the hospital lock, as shown in Fig. 1. This treatment has consisted of recompressing the man to the same pressure as that within the tunnel headings, reducing to the half pressure mark comparatively slowly. Thence on the reduction is very slow until atmospheric pressure is reached. This method has generally proved effective, unless the patient has been out of the tunnel for a long period, when the response to treatment, as a rule is not so ready.

In the opinion of the engineers and physicians on the work, the great freedom from "bends" has been due primarily to the very careful medical treatment examination of the workmen, to the shorter working shifts now enforced and to the rigorous enforcement of the method of decompression. In particular, probably the greatest factor has been the requirement that the men pass through the intermediate chamber when the air pressure has exceeded 22 pounds. This method of decompression is a modified form of stage-decompression. It is recognized as the most effective method of decompression that has been in use.

METHOD IN DETAIL

The intermediate chambers have averaged about 800 feet in length, and it has been customary for the men to come out of the heading through the first lock and into this chamber as rapidly as they desired. But, after walking through the intermediate chamber after the first decompression and entering the second lock, the time required for decompression in this lock has been the full period which would have been required if the men had come directly out of the headings, without the preliminary decompression. In this way the time consumed in decompression has considerably exceeded that prescribed by the New York State labor laws.

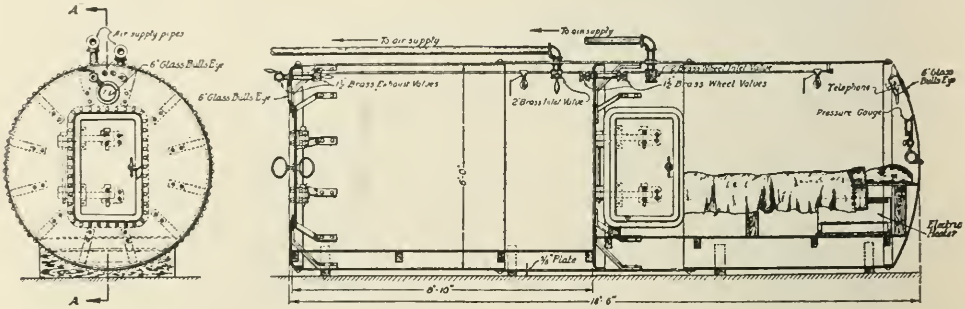


THE MEDICAL LOCK

CARELESSNESS OF THE MEN

The great difficulty in handling men who are working in compressed air is to make them feel that the precautions which are required by those in charge are not mere unnecessary hardships, but are for their benefit. The ordinary workman adopts the attitude that all requirements as to time and manner of decompression are a needless precaution, and are uncalled for obstructions to his exit from the tunnel heading. Consequently a careful watch has to be kept over the men in order to make certain that they do not decompress too quickly, by slipping out through one of the material locks. It has been found necessary to maintain a watchman on duty at each lock to check off each man as he enters and leaves the tunnel heading, thereby obtaining a record of the time taken in decompression. In this way, and in this way only, can proper decompression be insured.

From the experience thus far obtained on the work, it is felt that the dangers of com-



END VIEW

SECTION A-A.

DETAILS OF MEDICAL LOCK

pressed air illness can be largely eliminated in the higher pressures, provided the proper precautions are observed. In this connection the labor laws require that in decompression the air pressure in the lock shall be decreased at the rate of three pounds every two minutes, unless the pressure is over 36 pounds, in which event the decompression shall be at the rate of one pound per minute. In addition, the following requirements are fixed as to the hours of work in each 24 hours under compressed air:

Pressure Above Atmosphere.	Hours in Working Shifts.
0—22	8
22—30	6
30—35	4
35—40	3
40—45	2
45—50	1½

COMPLIANCE WITH THE LAWS

Each of the above shifts is divided as required by law into two parts, with an intervening period outside the tunnel. The length of the rest period varies from one-half hour at the lowest pressure to five hours at the highest pressure. It is apparent that the number of men required to carry on the work with tunnel headings increases very rapidly with the increase in air pressure. It has been found advisable in decompression to have the locks sufficiently large to permit the men as much freedom of movement as possible, as exercise stimulates the circulation and helps to eliminate the nitrogen from the tissues.

CARBONIC ACID DOES NOT COUNT

Regular tests have been made of the air in the tunnel headings in order to determine the amount of CO_2, the temperature and the saturation of the air, but, from observation of the results of these tests, and the number of cases of bends, the physicians are convinced that the amount of carbon dioxide thus far found has no effect on the number of cases of "bends." But the number of cases of "bends" has been found to increase markedly as the air pressure has been increased and the length of the shift remained unchanged.

SHORT SHIFTS FAVORED

Each time the shift has been shortened, although the pressure has been increased, there has been a distinct decrease in the number of cases of "bends" reported. For instance, with 3-hour shifts at 29 pounds, the number of cases of "bends" reported was 93 in 43,000 decompressions, while at 30 pounds with 2-hour shifts, the number of cases of bends reported was only 13 out of 23,000 decompressions, showing that it would not be advisable to increase the number of working hours beyond those now in effect.

FUTURE OUTLOOK

Although the work at the present time is far from completed, and as yet no experience has been had with pressures above 37½ pounds, it seems safe to assume that the record has been all that could be desired; and there seems no reason why it should not be continued under the high air pressures which will be required on the 14th Street and the 60th Street work. Complete records are being kept of all the data which appear to have any bearing on the study of compressed air illness, so that at the completion of this work the information obtained will be available for future tunnel enterprises.

In conclusion, the writer desires to state that this excellent record has been made possible only through the hearty coöperation of the Commission, its engineers and the contractors organizations. In particular he desires to express his appreciation of the invaluable assistance of Commissioner Whitney, who as Secretary, and later as Commissioner, has endeavored in every way to provide for the needs of the work, and also to Tunnel Engineer Clifford M. Holland, who has given much of his time outside the great engineering problems involved, to the study of this feature of the work, with which the writer is connected. From the *Public Service Record,* New York.

SPELLERIZING AS A STEEL TUBE PRESERVATIVE

Thorough investigation has shown that comparatively the greatest corrosion in service occurs to the smaller sizes of pipe on account of the thinness of the metal. The larger sizes are made from heavier plates of more uniform quality so that corrosion does not so seriously affect them.

To overcome the tendency of corrosion in the smaller sizes of steel piping a process in manufacturing has been devised, which is technically known as spellerizing. This process consists in subjecting the metal bloom to the action of rolls having regularly shaped projections on their working surfaces, then subjecting the bloom while still hot to the action of smooth faced rolls and repeating the operation, the surface of the metal thus being worked so as to produce a uniformly dense texture better adapted to resist corrosion, especially in the most objectionable form of pitting. The process is quite analogous to the kneading of dough and operates upon the metal all through instead of merely on the surface. The aim is to make the metal uniform and without the spots of varying texture from which pitting results.

As the process is entirely mechanical and does not in any way depend upon the skill of a workman, uniform treatment and results are assured. The process is applicable to the smaller sizes of pipe, say up to 4 inch.

Pipe has been made by this process for ten years in increasing amounts. The official records of the American Iron and Steel Institute show that during this period the percentage used of steel pipes has increased from 74.3 to 87.9 per cent.

Appended are some special experiences as to the use of this process and its effect upon steel pipe in actual service.

H. J. Macintire, Professor of Mechanical Engineering, Washington University, says in Power:

"In the case of ordinary steel pipe, mill scale is always present, and this likewise is electro-negative to the iron. If this scale is evenly distributed, as in Spellerized steel, the self-corrosion on its account will be slight; but if it is segregated, then local electrolysis and pitting of the material will result."

Morgan B. Smith, in the October, 1913, issue of *Ice*, states with reference to the merits of the Spellerizing process:

"Steel pipe, which has been treated in such a manner as to eliminate or at least distribute evenly the mill scale may be joined with wrought iron or cast iron safely as a rule. . . . The same stock without the treatment for mill scale will show a decided tendency to corrode when joined with wrought iron or cast iron. The so-called Spellerized steel fulfills this condition with respect to the scale."

R. B. Duncan, associated with the United Gas Improvement Company of Philadelphia, Pa., in a paper "Installation and Maintenance of Service," read before the Ninth Annual Meeting of the American Gas Insitute, 1914, states:

"The steel industry has been developing a new process which, after several years' time, has given many encouraging results. By this process the steel is treated mechanically and does not in any way depend upon skilled labor, beyond keeping up the machinery involved, hence uniform treatment is assured.

"This new process is a method of treating metal which consists in subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surfaces, then subjecting the bloom, while still hot, to the action of smooth faced rolls and repeating the action whereby the surface of the metal is worked so as to produce a uniform dense texture better adapted to resist corrosion, especially in the form of pitting."

The Gas Record, (issue of September 23, 1914, page 222), in commenting on Mr. Duncan's paper in regard to the Spellerizing process, says:

"The consensus of opinion is that modern steel pipe, particularly if Spellerized, is as durable as wrought iron, and is, besides, cheaper, stronger and more ductile and more uniform in composition."

Pipe steel made in 1906 by this roll-knobbling process tested against pipe steel made in 1897 resulted not only in a somewhat greater loss of weight by corrosion of the latter, but a decidedly deeper pitting of the 1897 steel in six months than occurred in the 1906 steel in thirteen months. In comparison with wrought iron it was found that the two materials lost practically the same weight by corrosion yet the steel had the advantage of uniform corrosion since the "wrought iron skelp pitted in seven months much deeper than the steel did in thirteen months." (Prof. H. M. Howe, Am. So. for Testing Materials, 1908).

A. Sang, in a thorough resume of the question, entitled "The Corrosion of Iron and Steel" (McGraw Hill Book Co., New York, 1910), says:

"The carefully acquired experience of the largest manufacturers of tubes in the world, which induced them recently to abandon the manufacture of wrought iron pipe, teaches that the use of steel in place of iron, at least in the United States, for the special purpose of tubing is to be preferred; the tendency of steel to pit is somewhat less than that of iron and it welds at the joint fully as well."

"There is very little, if any, difference between the corrosion on the wrought iron and the corrosion on the steel pipe. If anything, the wrought iron is pitted a little deeper, i. e., the pitting on the steel pipe is probably more general all over the surface, but the pitting on the wrought iron pipe is deeper in spots that are affected." (Proc. American Gas Institute, Vol. III, 1908, page 274).

"While the corrosion was about the same, there was a *pitting in the iron that we did not find in the steel,* and the steel was corroded more uniformly. From the tests made I know that the steel pipe is better for such conditions." (Supt. of one of the largest bituminous coal operations in the Pittsburgh district).

It is believed sufficient has been mentioned to show that the tendency of the Spellerizing process is to render the surface of pipe uniform and reduce the tendency to corrosion—especially in the form of pitting.

NEW JACKHAMER MOUNTING FOR THIN COAL SEAMS

BY H. L. HICKS

In the search for ways to increase production with a lessened working force there has been developed in the Scranton district a new system of mining the thin seams of anthracite common to that field. Under-cutting these thin seams by machine has been a slow and relatively costly process, and in many instances an impossibility, owing to bad bottom filled with sulphur balls. Hand-mining has nothing to recommend it and is excessively costly.

The new method is entirely one of boring and blasting, based on the use of compressed-air-operated Jackhamers and cruciform coal augers, with a special type of mounting, as shown in Fig. 1. While it is possible to work with Jackhamers without the mounting, its use is of decided advantage in reducing the fatigue caused by working in cramped positions, unavoidable in mining narrow seams.

The Jackhamer is the self-rotating hammer drill which is too well known in the coal-mining industry to need further description. The mounting which makes this new system

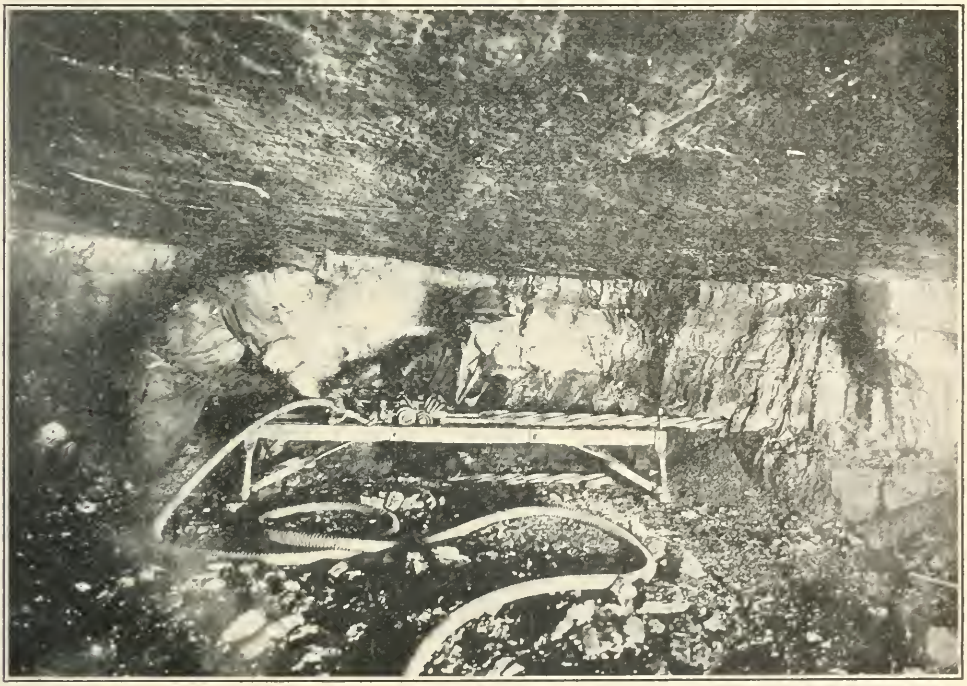


FIG. 1

practicable for narrow seams is simplicity itself—a frame carried on four legs, the principal feature of which is two rails on which the Jackhamer slides, the latter being held in a suitable carriage. Two hinged clamps with swing bolts quickly secure any standard Jackhamer or permit its convenient removal from the carriage, which in turn merely rests on the slide rails. The mounting, which is styled by the manufacturer Type JC-40, weighs 68 lb., the Jackhamer 43 lb. and the carriage, as stated, 20 lb. The working crew of drill runner and helper can easily pick up the entire outfit and shift it about as desired.

The distance from floor to center of drill when mounted is 12 in. Extension points, 12 in. long, give additional height where needed and permit the setting up for either flat or angle holes, as shown in Fig. 2. Hinged clamps at the forward end of the frame guide the auger steel and are of particular value in starting a hole.

A set of two steels 3 and 6 ft. in length is the usual practice, although 4- and 8-ft. steels are needed in special instances. Fig. 3 shows the standard steel, a twisted cruciform of 1⅞-in. diameter fitted with standard ⅞-in. hexagon Jackhamer shank and collar. Crossbits are used, with a gage variation of ⅛ in. between changes. Holes are usually bottomed at 2¼ in. Special dies for the Leyner sharpener insure gage exactness in bitting and resharpening this special auger steel.

In operating this equipment it is customary for both men to feed the drill forward on the mounting. It is noted that the positive rotation cleans the hole perfectly and in high drilling speed. Little dust is made.

The following examples outline the possibilities of this method of anthracite mining combination with the hammer action gives a and are representative of the usual practice. For this detail information the writer is indebted to William Wilhelm, of Scranton, Pennsylvania.

Fig. 4. represents a system of drilling a chamber 30 ft. wide where the coal is made up as follows: Top bony 2 in. thick, top coal 6 in. thick, sulphur and bony 4 in. thick and bottom coal 36 in. thick. The chamber is drilled with 12 holes. Eight are drilled in the top measure and four in the bottom. As will be noticed, the top holes are drilled on an incline toward the bottom, as shown. Hole No. 1 is 8 ft. deep, hole No. 7 is 7 ft. deep, and all others 6 ft. All holes bottom at 2¼ in. and are loaded with black powder as follows: No. 1 with 34 in., No. 2 with 18 to 20 in. and all others with 22 in. Great care is taken in tamping these holes; the tamping, with the exception of the opening hole, should always equal at least twice the amount of powder in each hole.

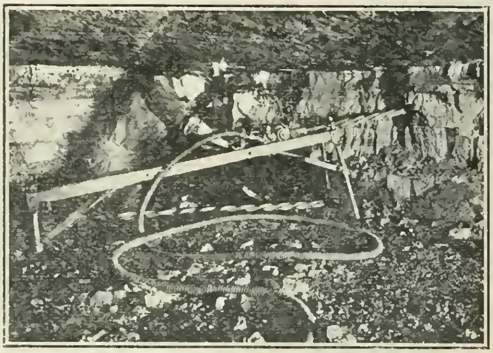


FIG. 2

For igniting and blasting it is found advisable to use an electric squib in the center of the charge rather than a miner's squib or safety fuse. When igniting the near end of a charge of blasting powder in a long borehole it is quite likely that a portion of the coal or rock will move out before the entire charge explodes and relieve the confinement of the powder in the far end of the hole where the burden is usually the heaviest and the greatest explosive force needed. The use of the electric squib requires 6 in. less powder than is possible with miner's squibs, and is safer and more economical, in that it permits the firing of four holes at a time if desired.

Holes are fired in rapid succession as follows: First No. 1, then No. 2, then Nos. 3 and 4, then Nos. 5 and 6 and the remaining holes in pairs. This layout requires 1¼ kegs of powder and will bring down approximately 26 tons of coal when the coal lays as shown.

The total drilling time for this 30-ft. chamber is from 45 to 50 min. for a drill runner and helper using a Jackhamer in the special mounting, giving a drilling speed of 1½ ft. per min. of the total time. With air pressure from 80 to 90 lb. the two men can easily drill six chambers in a working day of 8 hours.

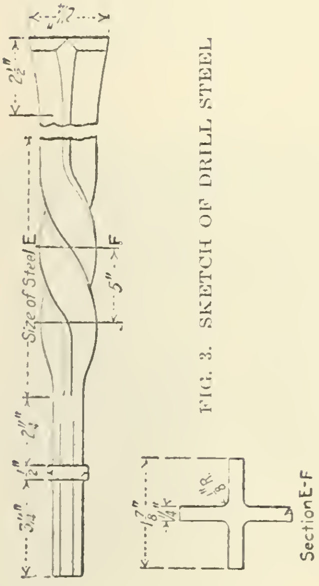


FIG. 3. SKETCH OF DRILL STEEL

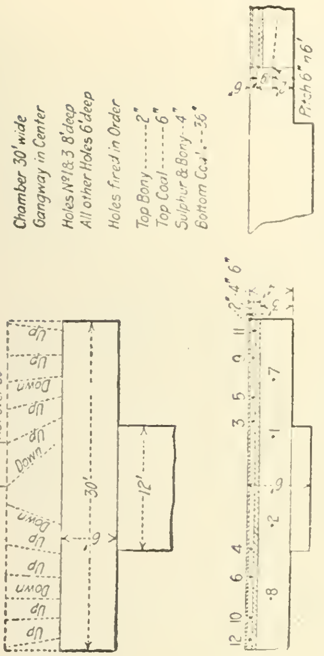


FIG. 4. LOCATION OF HOLES WITH GANGWAY IN CENTER WHEN TWO 8-FT. HOLES ARE USED

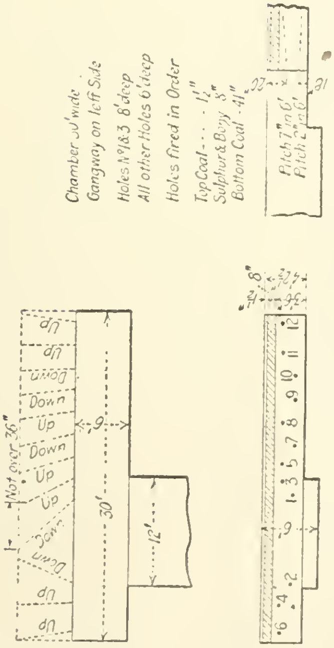


FIG. 5. METHOD OF LOCATING HOLES WITH GANGWAY ON SIDE OF CHAMBER

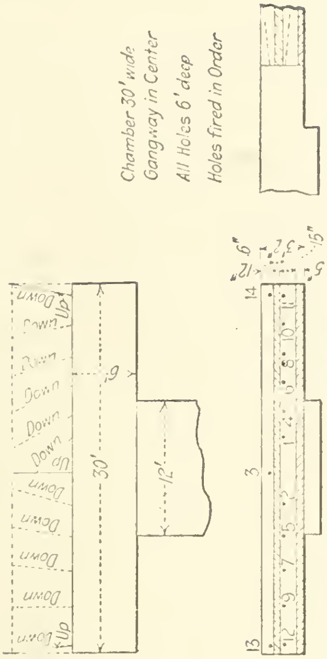


FIG. 6. METHOD OF LOCATING HOLES WITH GANGWAY IN CENTER OF CHAMBER

Fig. 5 also is a 30-ft. chamber. In this case the top coal is 1½ in. thick, a band of sulphur and bony 8 in. thick and bottom coal 31 in. thick. Twelve holes are required, drilled as shown. In this case the top hole pitches 7 in. in 6 ft.; the bottom hole pitches down 4 in. in 6 ft. Hole No. 1 is 8 ft. deep, No. 3 is 7 ft. and the others 6 ft. deep. These holes are loaded with black powder substantially as in the preceding layout. The order of firing is: Nos. 1 and 2, which make the opening cut, then 3 and 4, then 5 and 6, and then 7, 8, 9 and 10, and last 11 and 12.

It will be noticed that the gangway in this case is at the left. The object of this system, which is extensively used by the Delaware & Hudson Co., is to leave plenty of room on the side to gob the bottom rock and also leave an air opening from chamber to chamber for ventilation.

Fig. 6 shows a 30-ft. chamber in which the formation is: Top coal 12 in., sulphur and bony 6 in., bottom coal 15 in. and bottom rock and bad coal 5 in. All holes are driled 6 ft. deep. No. 1 is loaded with 24 in. and all others with from 18 to 22 in. of powder. These are fired as follows: First No. 1, then No. 2, next Nos. 3 and 4, and the remaining holes in pairs. In many cases the three holes shown drilled above the band of bony and slate are found unnecessary and are not used.

One of the marked savings with the Jackhamer method of mining is a reduction in the cost of loading the coal. By shooting, the coal is brought down in desirable sizes and it is estimated that five cars can be loaded in the time required to load three cars where the coal is undercut and dropped down.

The Jackhamer and coal auger is found to be practical in every case regardless of top roof or bottom rock and is claimed to bring down all the coal in convenient sizes. It is said to eliminate the plugging and barring out necessary with undercutting. The marked advantages of the equipment are its lightness and portability and the low upkeep. It is estimated that an outfit with two men will take the place of from eight to ten miners drilling by hand or will do three times the work accomplished by an equal number of men with other methods of undercutting and machine mining. This latter estimate is based on average observed performances of six chambers for the Jackhamer and two chambers for an undercutter in a working day of 8 hours.

In considering the installation cost of this equipment, account must be taken of the fact that many mines have been using unmounted Jackhamers instead of hand augers for their shothole work and that in these cases the proposition is but one of adapting existing equipment, with a possible slight increase in the number of machines. Where the purchase of new equipment is contemplated it is apparent the initial outlay for a Jackhamer outfit is very small compared with that of other types of machinery of equal producing capacity. Many mines have air available and many more are using portable mine-car compressors. Electrically equipped mines often find the latter form of air power more economical and convenient than permanent air piping from a central compressor.

While the system calls for approximately $1.20 worth of explosives per 30-ft. chamber in excess of the amount which would be used if the coal were undercut, this is more than offset by the increase in speed, saving in maintenance and repairs, and lessened overhead expense.

The Jackhamers in use are extensively employed for rockwork and rather than being an inconvenience, the new type of mounting shown in Fig. 7 is of advantage for this work. Long points or legs can be readily provided and a steel guiding clamp of proper size added at the opposite end of the mounting. By reversing the mounting, roof rock or slate can then be drilled as conveniently as coal.—*Coal Age*.

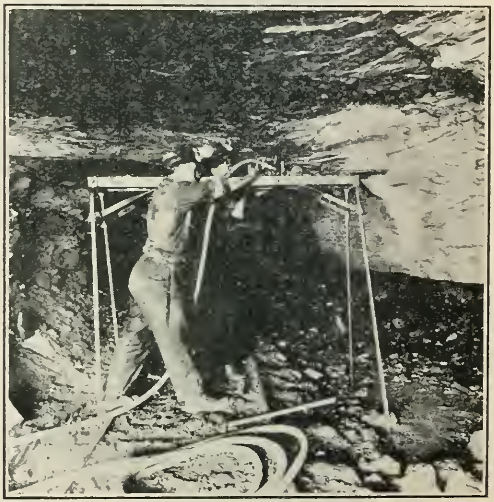


FIG. 7

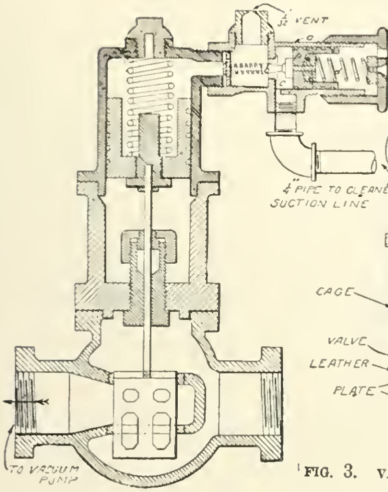


FIG. 1. VACUUM REGULATOR

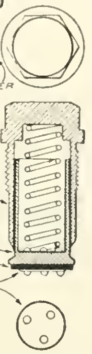


FIG. 3. VACUUM PUMP VALVE

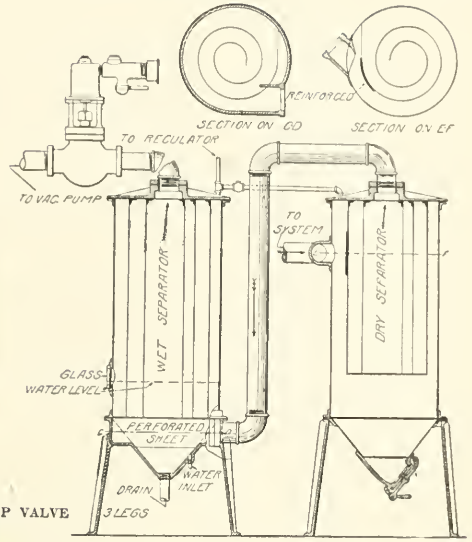


FIG. 2. SEPARATORS USED IN VACUUM CLEANING SYSTEM

VACUUM CLEANER EXPERIENCES

BY J. C. HAWKINS

Nearly every large office building, department store, hotel or large apartment house of today finds the vacuum cleaner indispensible, the equipment used being a complete system of piping throughout the building with the vacuum pump and appurtenances located where most convenient.

The principal trouble that we have experienced has been the maintenance of the proper vacuum, discharge valve trouble and the clogging up of the hose with objects picked up in cleaning. The machine is horizontal with cylinder 19-in. diameter by 12-in. stroke, driven at a constant speed of 150 r.p.m. by a 25-hp. compound motor through a 5-in. link belt chain drive. The suction header in the basement extends to all parts of the building, from which risers are taken to the several floors with convenient outlets to which a suction hose may be attached. Different kinds of fabrics require different kinds of tools and different vacuums to do the best work, and there may also be considerable loss in the line due to air leakage into the system.

In this plant it is customary to carry from 10 to 12 in. vacuum at the pump for light fabrics and fine work and 16 to 18 in. and sometimes more for heavy work, such as thick rugs, etc., which may be cut down at the tool if desired. With the machine running at a constant speed, the vacuum will vary over a wide range, depending on the use of the tool, unless some system of regulation is used.

Figure 1 shows the vacuum regulator. This is placed on the suction line between the separating tanks and vacuum pump. It consists of a 5-in. balanced valve having an extended stem to which is connected a piston working in a cylinder above the valve. This piston is a neat fit and is grooved to prevent air leakage, but has no rings. A spring above the piston assists gravity in keeping the valve open under normal conditions. Connected to the cylinder above the piston is a pilot valve which allows the vacuum to open or close the main valve, depending on the vacuum in the line. Referring to Fig. 1, this consists of the small cylinder, a, in which there is a piston connected to the threaded cap by a spring. There is also a small valve, b, usually held closed by a light spring assisted by atmospheric pressure. The ¼-in. pipe connects the end of the cylinder, c, to the suction line on the system side of the regulator and operates it in the following manner: With the vacuum pump running and regulating valve open, a vacuum is formed in the system and in chamber c of the regulator which, with the assistance of air pressure on the back of it, holds the pilot valve closed. The piston, p, is under tension of the vacuum with atmospheric back of it, but is held away from the valve by spring d in tension until the vacuum becomes strong enough to overcome the resistance of the spring and draws the piston against the pilot valve opening it. This places the chamber above the main piston in communication with the vacuum and the piston is drawn up, closing the main valve until the vacuum decreases to the point where spring d overbalances the vacuum and allows the pilot valve to close. Air entering the vent breaks the vacuum above the main piston. The vacuum may be regulated by screwing the cap carrying the spring and piston on, which decreases the tension required to draw it against the pilot valve; or to increase the vacuum, screw the cap off a few turns.

The dirt-laden air, before passing through the regulating valve and pump, must pass through a separator, shown in Fig. 2, consisting of two similar tanks 30 in. in diameter by 60 in. long having spiral plates nearly the full length. The air and dirt enter the dry separator near the top and pass around the spiral to the bottom, at which time the heavier particles of dirt are thrown out by centrifugal force, the air passing up through the center to the wet separator which it enters at the bottom and passes up through the body of water. It then passes up around the spiral, which throws out any entrained moisture by centrifugal force, and the air passes through the regulating valve to the pump.

Although the separator removes the greater part of dirt, a thin coating of scale and dirt will collect on the balanced valve, causing it to stick and prevent the regulator from working. Trouble has also been experienced from dirt collecting on the pilot valve and piston, putting the regulator out of commission. This makes it necessary to remove the parts of the regulator at intervals and clean them with coal oil or gasoline. We find that better operating results may be obtained if no oil is used on the pistons, or very little light oil, for the reason that it becomes gummy, collects dirt and causes the parts to stick.

The degree of vacuum obtained is read on a mercury column attached to the side of the dry separator on the system side of the regulator.

All turns in the suction piping system should be long radius to prevent rags, waste, string and other large objects from becoming caught in the bends; when this does happen, it is necessary either to blow back through the pipe with air pressure or fish the obstruction out with a steel fish wire.

The suction valves in the pump are of the Corliss type operated from the crank shaft through a reach rod. The discharge valves, five on each end, are of the spring-loaded poppet type working in cages as shown in Fig. 3. These valves are faced with leather for quiet operation, as they seat with a slam, and unless these leather seats are kept in good order the valves will either leak or become very noisy. These seats are riveted on with iron rivets to prevent their coming off.

At one time, we had no iron rivets of the proper size and copper rivets were used. After running the machine a few days, a heavy knock developed in the cylinder at the crank end center. The piston has little clearance and an examination of the cylinder with a small electric lamp dropped through the discharge valve opening disclosed the fact that the plate holding the leather on the valve which was riveted on with copper rivets had come off and dropped into the cylinder. It was fished out through the valve opening and no damage done.

The motor drives through a chain belt 5 in. wide from an 8-in. pinion on the motor to a 36-in. pulley on the pump, the distance between shaft centers being 42 in. The chain runs noiseless and is enclosed to prevent accidental catching of clothing. A mixture of flake graphite and engine oil is used as a lubricant and is applied to the working surface of the chain while running. The machine has been in operation intermittently for six years, and aside from minor troubles has given good service.—*Practical Engineer.*

AIRPLANE AND AVIATOR DEVELOPMENTS

The following is compiled by Mr. Fred. H. Colvin, recently Washington editor of *American Machinist,* being based upon the the experiences of British and French fliers as voiced by Wing Commander I. W. Seddon of the British Flying Corps, and Lieut Lagrange of the French Air Service.

THE AIR PROBLEM

The great air problem seems to be to get an overwhelming number of fast, single-seater, fighting machines so as to clear the air of enemy fighters. This not only enables you to take your own observations in safety, but to keep enemy observers away from your lines, to prevent bombers from attacking, and at the same time to allow your bombing machines to attack at will. This, however, is not considered to be an efficient mode of fighting, unless you can send huge squadrons of bombing machines that can completely wipe out a fortification or destroy bases or troops massed for attack. The present practice in the fast fighting machine is to have 1 hp. for every 10 or 12 lb. weight of machine, with the tendency to increase the power so as to give a horsepower for 8 lb. of machine. This means from 130 to 150 hp. for a small fighting machine.

AIRPLANE TESTS

The French engine tests for a motor of new design consist of a 50-hour run, divided over 5 days. There is a 5-hour run in the morning and a similar run in the afternoon. The first half-hour of each run is at full load and the remainder at 90 per cent. load, as this is all a motor delivers at 6,000 ft.altitude, the power decreasing as the machine ascends. New motors of accepted design are run for 3 hours, pulled down and examined, reassembled and run 20 min. They are then ready for service.

ALTITUDE CONDITIONS

The difference in temperature at different altitudes is a problem peculiar to the airplane motor. The low temperature of a high altitude cools the motor excessively at times, and this is particularly bad when diving from above to catch an enemy beneath. As the motor is shut off to dive, the water cools still more, in spite of the decreasing altitude; and when you throw on power again at the new fighting level, you have a cold motor that is not lively and will not develop the power you would like at that particular moment.

HIGHER SPEED MOTORS

It seemed to be the opinion of both the aviators that a higher-speed motor will be developed for the air service—not under 2,000 and probably 2,500 r.p.m. There are of course several which now reach the lower figure, but the majority are below that. This statement was taken to mean that there is a great probability of the cast-iron cylinder coming back, as it possesses better qualities for high-speed work than the steel cylinders that are being used on account of lightness. The motors must be in the neighborhood of 2 lb. per hp., some being even a trifle under that at the present time. The main thing at the present time, however, is to build all we can of the very best motor we know of and at the same time to make all the improvements possible.

SPECIAL AIRPLANE MECHANICS

The matter of ariplane mechanics is important, and it opens up a new and wonderfully interesting field for many shopmen who can do good work and particularly who know internal-combustion motors; for this is a war of internal-combustion motors in every important field of activity. We shall need thousands of good mechanics in the field as well as in the shop, and it presents an opportunity to many to do their bit in the way in which they can be of the greatest service. The first requirement is extreme care and conscientious work; for there can be no slighting in work of this kind, where not only the man's life, but the service he can render to his army depends on it. For this reason each flier has his mechanicians, generally two, who look after his machines and no others. This arrangement establishes a personal relationship between the flier and his men, which insures extra care and a quality of work that would be almost impossible under a "pooling" system, which may work out well enough on railroads and in similar places. The personal touch counts tremendously here and is taken full advantage of by the flying corps at the front. Every mechanic feels a personal interest in and responsibility for the flier to whom he is attached and is just as proud of his achievements as though they were his own.

HOW TO BE OF SERVICE

Every mechanic who wishes to be of direct service in this line should immediately begin to study the details of airplane construction, particularly of airplane motors, and also get in his application to the air corps of either the army or the navy, as he prefers. There will of course be many more opportunities in the army, at least in the beginning, and this service comes under the Signal Corps, which has divisional headquarters in various sections of the country.

STANDARDIZING

The Aircraft Production Board is hard at work on its project for a huge ouput of airplanes, as has been mentioned before. The situation appears to be nearing the point where there will be interesting developments to re-late. Arrangements for large production promise to be announced in the near future, as well as the standardizing of a motor that can be built, or rather manufactured, in large quantities and at a minimum cost. It has been developed along novel lines and gives promise of being the latest word in airplane-motor design and manufacture. It is understood that a standard cylinder has been adopted and that this will be combined in groups of four, six, eight or twelve, according to the amount of power desired. The cylinders will of course be interchangeable, developing possibly 25 hp. each, the motors ranging from 100 to 300 hp., according to the plane in which they are to be used.

A large number of training machines are under way, and the different training camps are constantly growing. The final training is likely to be done in France under the same weather conditions as will be encountered in fighting, the field at Avord being suggested for the bulk of this work. This is said to be an excellent field and to have a capacity sufficient for handling thousands of men. It is a city by itself, with workshops for repairs; and in this department it is said Chinese workmen have been giving an excellent account of themselvse.

This is one of the ways in which we can help also, by recruiting the working force from our shops in which similar work is handled, such as the better grade of automobile shops. Many of the French airplane shops are said to be undermanned, owing in a measure to the early mistakes of not exempting skilled mechanics in this line of work. A force of high-grade mechanics sent to France to assist in airplane work would not only greatly increase the production of machines, but would become thoroughly familiar with the methods of the French factories in this work and be of great assistance in this country in later developments of the air machines.

MAKING AIR PILOTS

It takes a special type of man to make a high-grade air pilot, and very severe tests are imposed in selecting the men for this work. Some of these tests seem unnecessarily severe and not calculated to get the right kind of men. But this will straighten itself out in time. The cost of training a first-class aviator is estimated at $4,000, which does not include the damage to machines. This item has, however, been greatly reduced by care and system and is now said to be less than 1 per cent. of the training machines.

All preliminary training is done in machines having a double control, so that an experienced pilot can be with the student to give him confidence and to assume control in case of necessity. After the student becomes expert enough to fly alone, he can use single-control machines that have been returned from the front as showing signs of wear and not being quite up to the mark for fighting machines.

WHERE TO APPLY

For the information of those who are interested in the flying corps, or "winged cavalry" as General Squires calls it, examination boards have been appointed at the following places in addition to the boards already located at the older flying stations: Urbana, Ill., Austin, Tex., Columbus, Ohio, Boston, Mass., Ithaca, N. Y., and Berkeley, Cal.

THE MOUNTAINS SUSTAINED BY FLOTATION.

The United States Coast and Geodetic Survey has determined that the crust of the earth on which the great mountain ranges stand is really lighter than other portions of the earth's surface. The mountains (at least in the United States) are not held up above the level of the sea by the rigidity or strength of the earth's materials but they are held in place by the fact that underneath them the materials (in the outer portion of the earth) are lighter than normal. The higher the mountain or the plateau, the lighter is the material under it. The principle is exactly the same as that involved in the floating of an iceberg in the ocean. The portion of the iceberg which is visible above the water is held up by the large mass of ice, with a density lower than that of water, in the submerged portion of the berg. So, in the case of the mountain mass, the portion above the sea level is held up by the lighter material under the mountain, which extends down to a depth of say, 60 miles. While the mountain is held up or floated by a lighter material under it, the bottom of the ocean is depressed because the material under it to a similar depth below sea level is heavier than normal.

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Those who fail to receive papers promptly will please notify us at once.

Advertising rates furnished on application.

We invite correspondence from engineers, contractors, inventors and others interested in compressed air.

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Vol. XXII. SEPTEMBER, 1917. No. 9.

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NO COMPRESSED AIR MISSIONARY NEEDED

It will be remembered that in our issue for May, 1917, page 8367, we reproduced two air pressure record discs from a pressure gage at a Scottish colliery. Our avowed purpose in reproducing the records was to call attention to the low pressure used and to suggest that pressures much higher would have been better practice. It appears that in this case we were more wrong than right all the way through, as the following letter shows. It is thought that no further explanation is necessary:

Editor Compressed Air Magazine.

Sir:—The critical note in your May issue referring to Compressed Air Pressure Diagrams from Chapel Coal Co. is based on complete misapprehension of the conditions of the Compressed Air service there.

The writer of the note misses the point illustrated by the diagrams, viz.: That the Compressing Plant which was too small for the Coalcutters when these Machines were operated without reference to each other, was amply large enough for the required daily output of coal when the working of the machines was suitably arranged according to time table. The time table involved no disadvantage in relation to the working of the pit, and the simple device obviated any necessity for addition to the compressing plant.

It is true that automatic control of the air pressure might have been fitted, but the diagram shows that under the conditions, hand control is quite effective, and that without involving any additional labor or other cost. (On general grounds it is unsafe to say of an even admittedly inefficient colliery plant that it ought to be scrapped and replaced, because the period of prospective life of the colliery is an important factor in the problem).

"The absurdly low pressure apparently regarded as satisfactory" is in fact the pressure most suitable to the conditions, and absurdity lies in the suggestion that it should be increased.

If the Coalcutters in use had been of the percussive type criticism of the low air pressure would be valid, but the machines are of the Longwall type, in relation to which air at comparatively low pressure is much to be preferred on the ground of efficiency. The Coalcutters are designed to work at 30 to 35 lbs. pressure, and increase of pressure would simply result in:

(a) Waste of power in compressing.

(b) Increased proportion of loss from pipe line leakages.

(c) Waste of power by exhausting at higher pressure from the Coalcutter.

In Longwall Coalcutters weight is a positive advantage, and there is therefore no difficulty in making cylinders of diameter suitable to give the required power at low pressure. To increase the pressure under these circumstances would be to reduce efficiency. A number of careful tests of the ratio of square yards undercut by machines per shift, to the brake horse power hours delivered to compressors per shift, in connection with Coalcutting Plant at a considerable number of collieries, have proved the superior economy of comparatively low air pressure for this particular service; higher pressures where installed have later been reduced, with marked improvement in economy.

MAVOR & COULSON, Limited.
Sam. Mavor,
Managing Director.

47 Broad street,
Mile-End, Glasgow.
July 6, 1917.

PNEUMATIC DISPATCH TUBES IN A FREIGHT YARD

The great length of the modern classification yard introduces a serious problem for the operating force through the difficulty encountered in securing adequate communication between the several parts of these large terminals. Telephones supply the necessary facilities for oral communication but the delivery of way bills and other papers from incoming trains to the main yard office, usually located at the hump, and from the main office to the conductors of departing trains, has been a source of great inconvenience and no small delay. As ordinarily administered conductors must either deliver or call for these bills at the hump office or they are carried by messengers, either method offering opportunities for serious loss of time, particularly if one or more bills are found missing when a train is ready to leave. Delays from this cause can easily amount to 30 minutes or more in each case.

The employment of messengers for this purpose and the delays incident to messenger service have been done away with at the Gibson yard of the Indiana Harbor Belt and the Clearing yard of the Belt Railway of Chicago, by the use of pneumatic tubes connecting the general offices, situated at the hump, with the offices at each end of the yard. At the Gibson yard the installation consists of lines of 3-in. steel tubing, running 4,350 ft. west and 4,650 ft. east of the hump, laid 3 ft. to 4 ft. underground. These tubes are open at both ends. In sending, a carrier is inserted in the terminal, the flapper is closed, and air is admitted behind the carrier by pressing a button, which actuates an automatic control device by means of which the air is delivered from a low pressure storage tank for a predetermined period sufficient to insure the arrival of the carrier at the other end of the tube. This air is supplied to the storage tank from the regular railroad service, having a pressure of 90 lb. to 110 lb. per sq. in. at the compressor. There are three cylindrical tanks, one at each sending point, that is, at the hump office and at the east and west yard offices.

At Clearing the tubes are 4 in. diameter and besides the two main lines, short leads connect with the office of the hump yard master and the switching tower at the hump. As these tubes will deliver a package a distance of about a mile in two minutes there is an obvious saving of time over any form of messenger service. At the Clearing yard this saving is estimated at 10 engine hours a day. That is to say, there is a saving of that amount in the time of the engine and train crews—say five men; and there is a potential saving of the per diem cost of the cars in the trains, the movement of which is expedited.

At the Gibson plant the maintenance expenses average $5.97 for three months' time, a figure which is said to be higher than normal. The carriers are handled by the regular clerk so that the expense to be charged for attendance is small. At Gibson the total number of carriers transmitted in a period of 24 hours recently was 220.

The tubes described were installed by the Lamson Company, Boston, Mass. The manufacturer is now recommending the use of motor driven cycloidal blowers at each terminal, so arranged that they run only when a carrier is in the line. This system is said to operate with a much smaller power consumption than in the case where the air is taken from the regular yard air service.—*Railway Age Gazette.*

REFRIGERATION FOR RIPENING FRUIT

As paradoxical as it appears, in several cases recently we have seen refrigeration used to force the ripening of bananas, says the *Fruit Dispatch.*

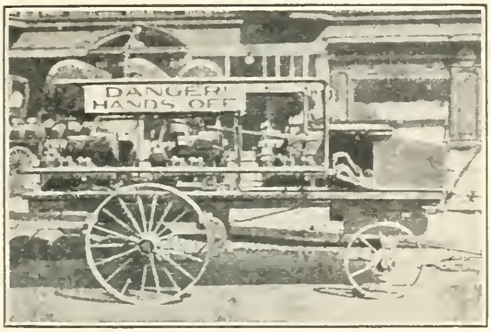
The bananas in insulated rooms were subjected to high temperature for a few hours, say 78 deg. for eight or ten hours; then the heat was turned off and after a short time cold air turned in, gradually cooling the rooms to a settled temperature of 60 to 62 degrees.

Checking the heat in the skin while the interior pulp is still warm and undergoing the ripening process appears to bring quickly a golden color, and the low temperature renders the fruit firm, even if there has been a tendency to soften it by excessive heat.

A RESUSCITATION CHART

The Bureau of Mines, Department of the Interior, Washington, D. C., has just issued a chart on the subject of resuscitation from gas asphyxiation, drowning, and electric shock. This chart is suitable for posting at the mines. in police and fire stations, bathing houses, and all industrial establishments in which there is danger from gas asphyxiation, drowning, or electric shock. It shows the Schaefer, or prone, pressure method of artificial respiration, which is the latest and most approved method advocated by eminent physiologists of the country. The bureau is issuing this chart in the hope of inducing the adoption of this standard method of resuscitation throughout the country, and with the hope that the instructions presented on the chart may result in the saving of human life. Copies of this chart will be sent free of charge to all persons requesting it as long as the edition remains in stock.

Great Britain has about 5 per cent. as many motor cars as this country has, or 171,607. New York, Ohio, Pennsylvania, Illinois, Calиfornia, Texas and Iowa each have more cars than has Great Britain.



THE COMPRESSOR

HOME-MADE COMPRESSOR RIG. CHEAP TIE TAMPING

When the matter of using pneumatic tampers was brought to the attention of the San Francisco-Oakland Terminal Railways, the first cost was a prime consideration owing to the widespread need of retrenchment. It was happily suggested, however, that the cost of the compressor, say $500 or more, could be saved by using some old railway compressors.

The suggestion was carried out by mounting a battery of six 11-cu. ft. capacity pumps on a truck as shown in the illustration. The actual capacity required for the two Ingersoll-Rand tampers used is only 32 cu. ft., but double capacity was installed because the old machines were not good for continuous service at more than 50 per cent. loading. These tampers have proved particularly successful in tamping heavy special work. On this railway the machines have allowed six men to do the work which formerly required sixteen. Of the six men one is stationed to flag vehicles while another handles the connection to the trol-

TIE TAMPERS AT WORK

ley wire, leaving the remaining four to do the tamping.

With labor at $2.50 a day, the relative costs are: Air tamping, $15; hand tamping, $40—a saving of $25 a day. As a matter of fact the tampers paid for themselves within ten days. These tampers are also used for flat tamping of ballast in advance of concreting. They are fitted with chisels when wanted for clipping concrete and with cutters when used in stripping out asphalt.

A SHAFT-SINKING RECORD

Since the discovery of the United Verde Extension Mine the district about Jerome, Ariz., has received a great deal of attention from mining engineers and operators. Prospecting resolved itself first of all into a question of shaft sinking, and the development companies formed were organized on a basis permitting sinking a shaft to 1,200 or 1,400 ft. before crosscutting and drifting commences. Under these conditions it was natural to look for something pretty good in shaft-sinking records, and the Gadsden shaft is the first one to "draw blood."

The Gadsden is a development prospect of the Calumet & Arizona Mining Co. It is in the mineral belt about 1½ miles south and east of Jerome. The work is under the general direction of John C. Greenway, general manager of the Calumet & Arizona at Bisbee, and J. K. Hooper is the superintendent directly in charge. It was decided to open the property by a shaft to approximately the 1,000-ft. level before drifts were run.

The shaft is 5 ft. x 17 ft. 10 in. in the clear, divided into two hoisting compartments and a pipe and manway; 12x12-in. timbers are used, and the ground is broken about 8x21 ft. The surface plant consists of a 220-hp. direct-motion electric hoist, an 888-cu. ft. Imperial belt-driven compressor and full blacksmithing equipment, including a No. 5 Leyner sharpener.

By May 1 the work was well under way. A satisfactory bonus rate had been worked out by Mr. Hooper, and the men were instructed to go to it. For seven consecutive days the shaft went down nine feet a day, and no part of the work was allowed to drag. The shaft was close timbered, guides, ladderway, air and water pipes kept up each day. During the month some time was lost because of power trouble and the Jerome strike tied the work up several shifts; in spite of all this a grand total of 202 ft. was made for the month—a record which is now a mark for all the properties in the district.

The Gadsden shaft during the record month was in limestone, which varied from a fairly solid uniform drilling rock to a shattered fitchery ground. The regular shaft round was used, cut holes running from 10 to 12 ft. deep. Five Ingersoll Jackhamers with ⅞-in. hollow hexagon steel were used, and no difficulty was experienced in drilling the deep holes, steels being fitted with standard four-point bits. All holes were loaded with 40 per cent. and 60 per cent. gelatin powder, the 60 per cent. being placed in the bottom of the holes.

At the end of the month the shaft was in excellent condition, no detail having been slighted.—*Eng. and Min. Journal.*

SUCCESS OF THE DRILL WAGON

In the 1916 edition of Gillette's "Handbook of Rock Excavation," comment is made upon the growing tendency to use very large drills where the surface of the rock is comparatively level and the holes comparatively deep. A level surface permits mounting the drilling outfit on wheels, enabling the drill to be moved speedily from hole to hole.

It has not been regarded as economic to use large drills (with 5-in. cylinders, such as are designed for subaqueous drilling) in drilling shallow holes or where the surface of the rock is very irregular. But the recent economic success of such drills in deepening the channel of the Mississippi at Le Clair, Iowa, known as the Le Clair Canal, seems to warrant serious consideration of large drills even for shallow holes and where the rock surface is rough. This work involves making a rock cut nowhere more than 5 ft. deep, in an unusually "spongy" limestone full of holes and having an uneven surface. Air hammer drills (Jackhamers) were tried at first, but crumbling rock clogged the bits, even when water jets were used, to such an extent that they were abandoned.

The problem was solved by mounting two Ingersoll-Rand slab-back drills on a flat car. The mounting is somewhat similar to that on a drill boat. Each drill is mounted in a sort of pile-driver frame, so that it can be raised and lowered with a hoisting engine, and the frame can be moved laterally along a runway, this being 30 ft. long for the two drills. The flat car that carries the drills, boilers, etc., travels on track sections, 10 ft. long, like a steam shovel. Each drill has averaged 110 ft. per 8-hour shift. A water jet was used to good advantage.

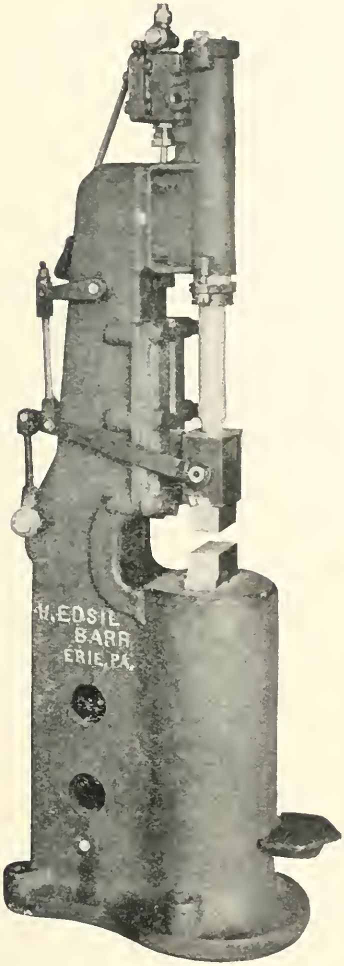
The solving of this problem of drilling economically in a very bad rock is highly creditable to the engineers in charge—Maj. G. M. Hoffman, Corps of Engineers, U. S. A., J. B. Bassett and H. E. Reeves, assistant engineers. The question that we now raise is whether a drill-car outfit of this kind is not adapted for shallow drilling even where the rock is sound. If 110 ft. per drill can be daily averaged under bad conditions, it is evident that considerably more can be averaged under ordinary conditions. Probably in solid rock and for shallow holes a smaller size of drill would serve, and in that case, it might be feasible to use runways longer than 30 ft., and perhaps provide a runway at each end of the drill car so that four or maybe six drills could work simultaneously.

IMPROVED PNEUMATIC HAMMER

The half tone shows the latest improved light pneumatic forging hammer built by H. Edsil Barr, Erie, Pa., the latest improvement comprising an automatic gear which permits continuous striking with a rapidity up to 200 blows a minute. Compressed air at the ordinary shop working pressure of 80 to 90 lb. gage is used, the speed and force of the blow being entirely under the control of the operator by means of a foot lever, leaving the hands free for manipulating the work.

In the design and construction of the hammer the aim has been to produce a strictly one man machine of maximum adaptability and of rugged and durable character. The valve gear requires no readjustment or attention in striking and reversing on any thickness up to 2 in., and the maximum speed and force of blow automatically results on the thicker material where the heaviest reduction and maximum effect in working the iron to the center is required.

Careful attention has been given to every detail both of material and workmanship, and the result is a thoroughly reliable machine as is evidenced by the numbers in use and the wide range of work.



The maximum stroke of the hammer is 10 in. The dies furnished are plain forging dies of a special tool steel, die temper, annealed and then hardened on the faces, both dies being readily removable for substitution of special dies as may be required.

The total weight of the hammer as here shown is 1,200 lb.; floor space, 14 in. by 24 in., and height, 5 ft. 6 in.

HAMMER DRILL RESENTS OVERPERSUASION

Every accident teaches a lesson, or should teach one; also, it occasionally happens that an accident very efficiently teaches a much-needed lesson, and at the same time comes within the "Purely Accidental" classification of the State mine inspector. The case of Bernardo Ortiz belongs to the latter kind. Bernardo is a machine man in the mines of the Phelps Dodge Corporation, at Morenci, Ariz. Up until ten days ago, he believed in the time-honored method of pounding on the machine with a double-jack, piece of steel or any other handy weapon in case the machine refused to respond to his expert touch. But Bernardo is not now of that faith. Something happened that suddenly changed his mind. The occurrence was this: He was drilling in a raise with a B. C. 21 Ingersoll-Rand stopehamer. Essaying to change to a longer drill, he found that the steel was stuck in the chuck. As per custom, he seized the 6-lb. hammer lying by and plied same with vim. For was he not working on a contract? He brought the hammer down on the fronthead, which stood just a little above the man's waist. At the last stroke he gave the machine, however, a piece of steel about the size of a .22 caliber bullet flaked off the edge of the fronthead and entered the man's abdomen, perforating his large intestine and an artery. The doctor found the bullet in the neighborhood of the man's kidneys, and the patient is getting well. The State mine inspector is satisfied the accident was not the company's fault, and the operators are satisfied the Spaniard will not hammer the machine again.—*Eng. and Mining Journal.*

NOTES

The Ingersoll-Rand Company announces that, at a meeting of the Board of Directors of the Company, Mr. J. H. Jowett, formerly General Sales Manager, was elected Vice-President of the Company, and that Mr. L. D. Albin, formerly Assistant General Sales Manager, was appointed General Sales Manager. Mr. Jowett and Mr. Albin will continue to make the Company's New York office, at 11 Broadway, their headquarters.

The Du Ponts, of powder fame, are said to have on their payroll, 2,000 chemists, who, among other things, are conducting research work preparatory to giving Germany a "run for its money" in the production of dyes.

The city of Pernambuco, Brazil, is installing a new system of street numbering. The metric system is used. If for instance the number of a house is 134, then that particular house is 134 meters from a certain starting point. The house across the street would be 135 meters or the nearest number to the actual distance from the starting point. There is no telling what the metric craze may lead to.

At the cantonment near Atlanta, Ga., gas furnaces are to be installed for the production of a ton and a half of peanut brittle per day for the soldiers there.

There are 450 irrigation companies in California, and it is estimated that they will irrigate a million more acres in 1917 than in 1916.

It is believed that the driest place in the world is that portion of Egypt between the two lower falls of the Nile. Rain has never been known to fall there.

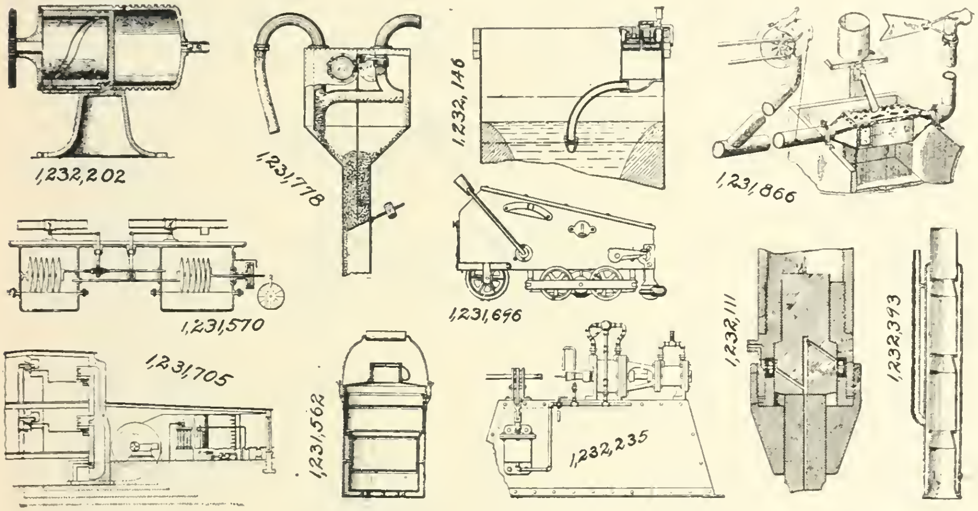
Fifty million barrels of fuel oil (50,000,000), or nearly three times the total production of crude petroleum in Southern Texas and Southern Louisiana during the entire year of 1916, according to Secretary Daniels, are to be ordered by the United States Government for the use of the navy alone.

Argentina is developing oil-fields in Patagonia and in other parts of the republic. A recent report by the Argentine Bureau of Mines affirms that the petroleum deposits of Rivadavia on the Patagonian coast promise to rank among the most important of the world.

In June, 1914, aluminum sold for 17.5 cents per pound. During the war the price has gone up to 60 cents on account of its demonstrated value in the making of explosives. Mr. Arthur V. Davis, president of the Aluminum Company of America, has offered to supply the U. S. Government with all the aluminum it needs at 27.5 cents per pound.

The air in water is undoubtedly one of the causes of the rusting of water pipe. Mr. H. R. Holmes, an engineer of Pensacola, Fla., proved that an excessive amount of air in the water was the cause of an unusual rapidity of corrosion of pipes. The corrosion was so rapid that it had been attributed to electrolysis, but Mr. Holmes not only showed that no appreciable electric currents existed but that the corrosion of the pipes was mostly on the inside and at the top where air bubbles were liberated. Water drawn from a faucet into a glass liberated bubbles of air in abundance.

Two ears of corn a year per acre were paid by the Lehigh Coal Co. in 1792 and following years for the lease of large areas of coal land. The bulk of the coal-bearing lands were patented by the State of Pennsylvania from 1795 to about 1816, the payments made by the grantees being $2 to $4 per acre. During the 40's and 50's of the last century $50 per acre was a good price, but by 1875 the value of the best land had risen to $500 an acre. This value rapidly increased until at the present time $3,000 per acre is considered only a fair price for good virgin coal land, and but little of this has come on the market for years.



Pneumatic Patents July 3

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JULY 3.

1,231,562. VACUUM DINNER-PAIL. Byron J. C. Brueger, Ladysmith, Wis.

1,211,570. REGULATOR FOR AIR-CONDITIONING APPARATUS. Stuart W. Cramer and William B. Hodge, Charlotte, N. C.

1,231,696. VACUUM-CLEANER OR COMBINED VACUUM-CLEANER AND CARPET-SWEEPER. Bernard John Bouwmeester, Grand Rapids, Mich.

1,231,705. APPARATUS FOR REGULATING THE HUMIDITY AND TEMPERATURE OF AIR. Willis H. Carrier, Buffalo, N. Y.

1,231,777. CUSHION PNEUMATIC HEEL. Oscar Mussinan, New York, N. Y.

1,231,778. PNEUMATIC GRAIN ELEVATOR AND SEPARATOR. Charles P. Nall, Minneapolis, Minn.

1,231,866. MILK-AERATOR. Michael Duvall, Lincoln, Wis.

1,232,111. ROCK-DRILL. Michael Smith, Bisbee, Ariz.

1,232,146. MANUFACTURE OF ICE. William P. Wiemann, Pittsburgh, Pa.

1,232,202. AIR-COMPRESSOR. Emmet J. Brown, Terre Haute, Ind.

1,232,235. HOLLOW-DRILL STEEL-PUNCHING MACHINE. Thomas Davies, Jerome, Ariz.

1,232,393. AIR LIFT-PUMP. John S. Piper, Lawrenceville, Ill.

JULY 10.

1,232,475. SAFETY ATTACHMENT FOR AIR-BRAKE SYSTEMS. Eugene Arrington, Ridgely, W. Va.

1,232,494. APPARATUS FOR THE MANUFACTURE OF GLASS. James A. Chambers, Pittsburgh, Pa.

1,232,506. APPARATUS FOR ATOMIZING HYDROCARBON FUELS. Anthony Costa, Cleveland, Ohio.

1,232,557. FLUID-CONTROLLING VALVE FOR GOVERNORS. Henry D. Johnson, Dumfries, Va.

1,232,585. PNEUMATIC HAMMER. Arthur J. McQuaide, Canton, Ohio.

1,232,618. SPRAYING OR ATOMIZING DEVICE. Walter J. Smart, New York, N. Y.

1,232,640. FEEDING AND BURNING FINE FUEL. Walter D. Wood, New York, N. Y. James W. Lynch, East St. Louis, Ill.

1,232,703. BOTTLE-BLOWING MACHINE. James W. Lynch, East St. Louis, Ill.

1,232,726. PNEUMATIC-TIRE-TUBE VALVE. Sidney C. Sladden, New York, N. Y.

1,232,787. FLUID-PRESS FOR RUBBER FOOTWEAR. John R. Gammeter, Akron, O.

1,232,797. FLUID-PRESSURE-CONTROLLED REVERSING-GEAR. Theodore A. Hedendahl, Denver, Colo.

1,233,177. VISCOSIMETER. Charles H. Briggs, Minneapolis, Minn.

1. A viscosimeter for measuring the rate of flow of material under a predetermined suction thereon, comprising a test tube having a free open end adapted to be placed against the material to be tested, means for producing a predetermined diminution of pressure in the test tube, whereby the material is drawn into the same, and a graduated scale associated with the test tube for measuring the viscosity of the material.

1,233,275. AIR-COMPRESSOR. Charles Volney Kerr, East Orange, N. J.

JULY 17.

1,233,336. PNEUMATIC PLAYER. Charles Freborg, Kankakee, Ill.

1,233,367. PNEUMATIC DEVICE FOR PLAYER-PIANOS. Otis M. Kennedy, Philadelphia, Pa.

1,233,408-9. VACUUM-CLEANER. John W. Shanahan, Grand Rapids, Mich.

1,233,410. MACHINE FOR CLEANING TOBACCO-PIPES AND THE LIKE. Frederick Hudson Shepherd Shepherd, London, England.

1. In valve construction, the combination of a flat annular valve of limited thickness, a valve-seat-forming member having an annular shoulder to form a seat for the valve at its inner edge, another annular seat-forming member having also a shoulder which is concentrically spaced from the shoulder first mentioned to form a port between them and constituting a seat for the valve near its outer edge, springs to hold the valve to these seats, a valve head provided with openings and means to attach the seat-forming members to this head.

1,233,696. FLY-CATCHER. Harry Pakeman, Columbus, Ohio.

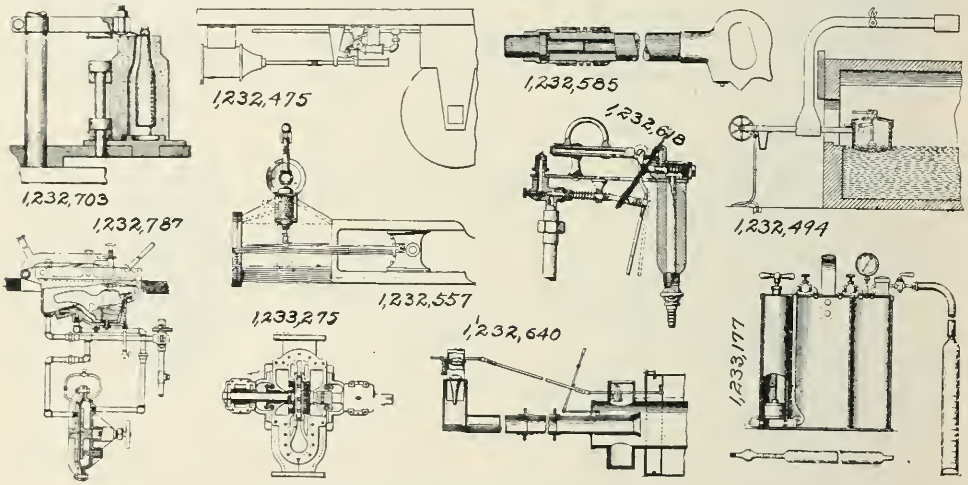
1,233,723. DRILL-SHARPENER. William A. Smith, Denver, Colo.

1,233,844. AIR-STRAINER FOR AIR-COMPRESSORS. Nelson T. Cline, Pittsburgh, Pa.

1,233,923. PNEUMATIC VALVE MECHANISM. Richard T. Schriber, Guss George, and William H. Meacham, Alton Park, Tenn.

1,233,928. HAND-CONTROLLED VACUUM-CLEANER. Howard Small, Wyncote, Pa.

1,233,944. AIR-GUN. Adolph Wissler, St. Louis, Mo.



Pneumatic Patents July 10

1,233,438. SELF-PACKING FLUID-PRESSURE DEVICE. Luis Salles Barengueras, Habana, Cuba.

1. In a fluid compression device the combination of a cylindrical casing, a piston movable in the casing and without friction or contact therewith, the wall of the piston being provided with a plurality of waved grooves, whereby a packing is effected between the piston and the casing on compression of the fluid on one face of the piston by the production of counter currents in the fluid.

1,233,460. AIR-COMPRESSOR FOR INTERNAL-COMBUSTION ENGINES. Guido Fornaca, Turin, Italy.

1,233,555. APPARATUS FOR CLEANING AND HEATING AIR. William F. Cox, Danville, Va.

1,233,581. ROTARY COMPRESSOR OR EXHAUSTER. John Johnston, London, England.

1,233,594. AIR-PRESSURE - LIMITING DEVICE. James H. Mitchell, Denver, Colo.

1,233,668. MILKING-MACHINE. Arthur V. Hinman, Oneida, N. Y.

1. In a milking machine, a power-driven individual vacuum pump, a vacuum pail connected to be exhausted thereby, teat cups, and means for producing pulsations in the cups by the movement of the pump piston, whereby the milk is drawn from the cow into the pail.

1,233,693. COMPRESSOR. Edwin M. Niebling, Cincinnati, Ohio.

1,233,948. VACUUM-CLEANER. Morris S. Wright, Worcester, Mass.

1,233,982. AERONAUTICAL MACHINE. Frank Clark, Throop, Pa.

1,233,991. SUCTION-CREATING APPARATUS. Philippe L. Des Jardins, St. Louis, Mo.

1,234,062. AIR-PISTOL. Charles W. Matz and Clyde H. Hale, Evanston, Ill.

1,234,095. VACUUM CLEANING APPARATUS. John J. Duffie, Berkeley, Cal.

1,234,097. ROCK-DRILL. George H. Gilman, Claremont, N. H.

JULY 24.

1,234,130. ELECTRICALLY - DRIVEN TIRE-INFLATING PUMP. Benjamin S. Cartwright, Oelrichs, S. D.

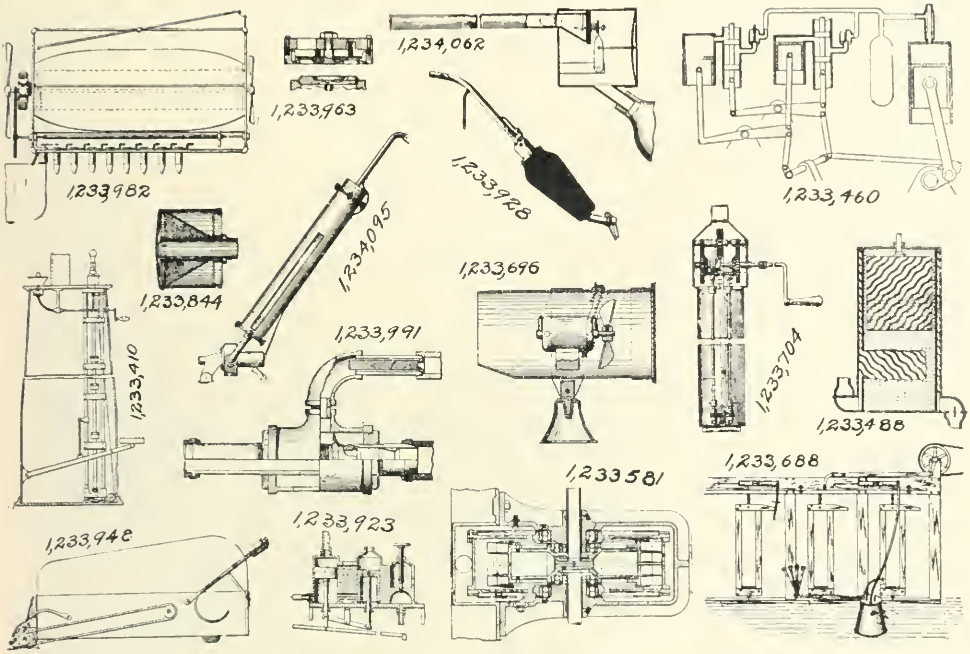
1,234,214. INSECT - ERADICATOR. Mercer Reynolds, St. Elmo, Tenn.

An insect eradicator comprising a complete circuit for air with means for forcing the air through the circuit, means for drying the air, means for heating the same, conveyer means in the circuit for the passage of the material to be treated and means for filtering the air on its passage to the air forcing means.

1,234,281. PNEUMATIC CONVEYER. Charles H. Burton, Washington, D. C.

1,234,378. AIR-BRUSH. Charles H. Parkin, Cleveland, Ohio.

1,234,446. PORTABLE BLOWER. Horace E. Clark, Kirkwood, Ga.



Pneumatic Patents July 17

1,234,505. GAS-VOLUME STANDARD FOR TESTING VOLUME-MEASURING APPARATUS FOR GAS. Marcus H. Stillman, Washington, D. C.

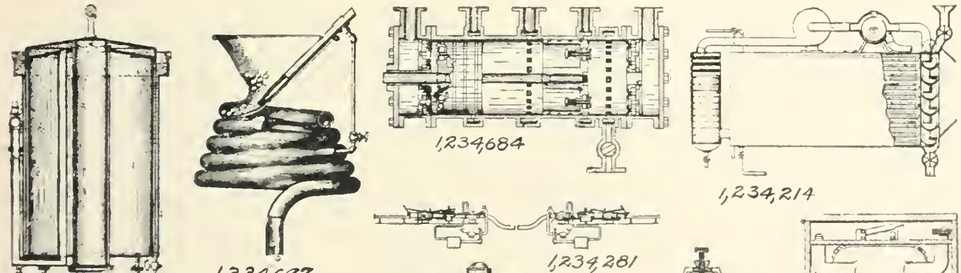
1,234,560. PNEUMATIC MOTOR FOR FLUE-CUTTERS. Harvey D. Palmer, Topeka, Kans.

1,234,598. SUCTION-MACHINE. John Wynn, Jr., Canton, Ohio.

1,234,684. COMPRESSION-PUMP. Edwin M. Niebling, Cincinnati, Ohio.

1. In a compressor, the combination of a cylinder, valve-controlled gas-outlets in each of its ends, pistons coupled together with a space between them, reciprocating between these ends, a central inlet midway between the ends of the cylinder to admit gas at low pressure to the cylinder-space between the pistons, an additional inlet between this central inlet and each end of the cylinder to admit gas at high pressure into each of the spaces between each end of the cylinder outside of each piston, openings in each piston to permit gas from the space between the pistons to pass into the spaces outside of them and between them and the ends of the cylinder and spring-actuated valves to control these openings.

1,234,697-8. APPARATUS FOR REMOVING STEMS FROM FRESH FRUIT. John B. Foote, Oak Park, Ill.



Pneumatic Patents July 24

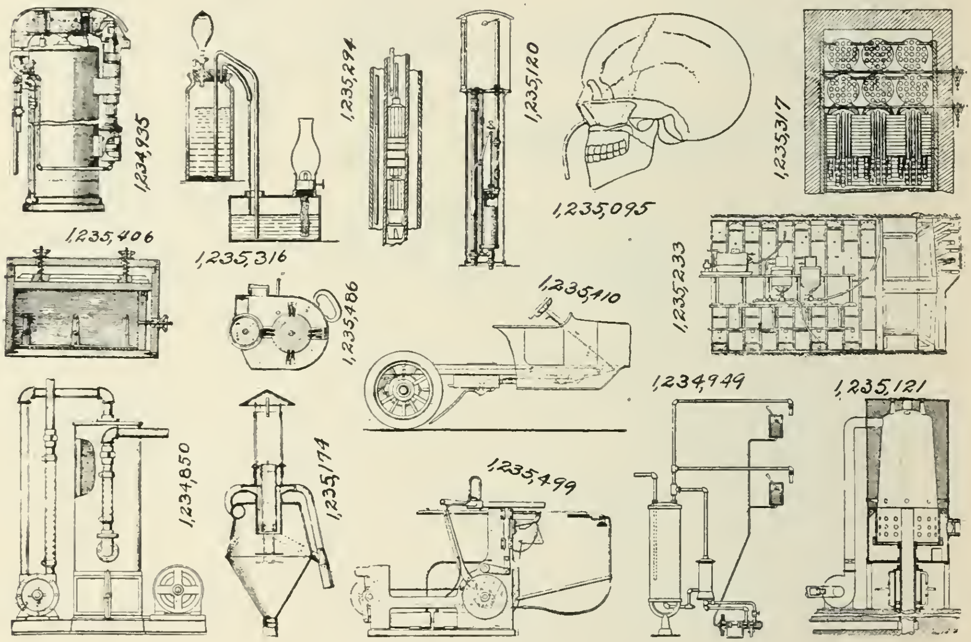
1. Apparatus for stemming fruit comprising a runway having a substantially smooth surface on which the fruit is free to roll and which, when struck by the stems of the fruit will sever them, the runway being formed so the fruit will roll without being crushed, and fluid means under pressure for propelling the fruit through the runway.

JULY 31.

1,234,850. COMBINED VACUUM - CLEANER AND BLOWER. Ernest L. B. Zimmer, Oakland, Cal.

1,234,908. VALVED AIR-PUMP. Jesse E. Keppel, St. Louis, Mo.

1,234,935. SAUSAGE-STUFFER. John M. Peterson, Chicago, Ill.



Pneumatic Patents July 31

1,234,949. REMOTE CONTROL MEANS FOR WATER-HEATERS. Elmer S. Stack, West Somerville, Mass.

1,235,095. INFLATABLE SURGICAL PACKING. Augustus L. Beck, New Rochelle, N. Y.

1. A pneumatic packing for the purpose described comprising a closed flexible bag whose shape is conformed to the nasal chamber and having comparatively resistant ends, and an inflating tube leading into one end of said bag.

1,235,120. LIQUID - MEASURING DEVICE. Frederick William Delanoy, Alameda, Cal.

1,235,121. FURNACE-GRATE. Henry L. Doherty, New York, N. Y.

1,235,174. PNEUMATIC SEPARATOR. Milton F. Williams, St. Louis, Mo.

1,235,233. METHOD OF TUNNEL CONSTRUCTION. John F. O'Rourke, New York, N. Y.

5. The method of constructing tunnels consisting in making a tunnel boring for a shield, erecting a tunnel lining within the tail of the shield, advancing the shield along said lining, and blowing a current of air carrying loose solid material into the space outside of the lining behind the tail of the shield against the lining and the wall of the boring, compacting said material to at once support the surrounding ground.

1,235,294. APPARATUS FOR CLEANING DEEP WELLS. George W. Deats, Forth Worth, Tex.

1,235,316. AUTOMATIC SIPHON-REGULATOR. Charles H. Henderson, Port Orchard, Wash.

1,235,317. BOILER-TUBE CLEANER. Samuel J. Herman, Detroit, Mich.

1. The combination with groups of tubes arranged in adjacent rows with baffle plates intermediate the adjacent groups at one side of the row, of a blower tube extending between rows transversely of said groups and parallel to said baffles, jet nozzles upon opposite sides of said blower tube dissimilarly distributed, the nozzles on one side covering the area of each entire group of tubes and the nozzles on the opposite side being limited to a portion of each group and avoiding the baffles, and means for rotatively adjusting said blower tube limited to a partial revolution thereof.

1,235,406. PNEUMATIC FEEDER. Samuel Williams, Elk City, Okla.

1,235,410. SANDING DEVICE FOR VEHICLES. Henry Adam Alheit and John Anton Boyken, New York, N. Y.

1,235,486. COTTON - PICKER. Oscar D. Killebrew, Richmond, Va.

1,235,499. PNEUMATIC BLANK-TRANSFERRING MECHANISM. Melville E. Peters, George H. Fath, and Albert F. Miller, Denver, Colo.

1,235,500. AUTOMATICALLY - OPERATING BLANK OR LABEL FEEDING MECHANISM FOR BLANK-GUMMING MACHINES. Melville E. Peters, George H. Fath, and Albert F. Miller, Denver, Colo.

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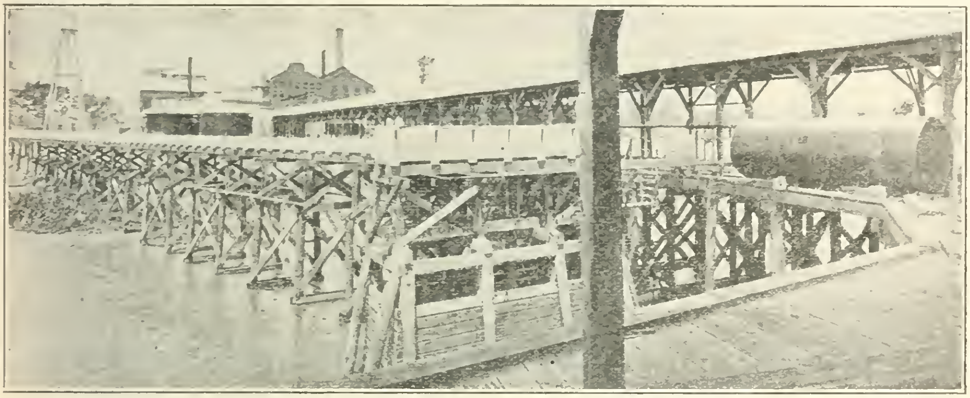


FIG. I. AIR LIFTS AT SAVANNAH SUGAR REFINERY

THE AIR LIFT RUNS SAVANNAH'S GREAT SUGAR REFINERY

A new sugar refinery at Savannah, Ga., with a capacity of 1,000,000 pounds of sugar a day, has been built in record time by Westinghouse, Churck, Kerr & Company, for the Savannah Sugar Refining Corporation. It is located on the bank of the river about 8 miles above the city with docks at which its cargoes of raw sugar are received direct from Cuba.

Savannah is now regarding this plant as its greatest industrial asset, not only for its own intrinsic value to the city, but for its attracting to the same location of many other important industrial installations, with the accommodations for a large population of workers who must live in the vicinity.

The enterprise is written up in a complete and interesting manner in a recent issue of the *Manufacturers' Record,* of Baltimore, from whose pages our illustrations are reproduced. We can give our attention to only one feature of the plant, which is its effective provision for an adequate and reliable water supply. The requirement was for 10,000,000 gallons per day, a volume equal to the entire normal consumption of the city of Savannah. As the water was to be pumped from the river steam pumps would naturally first be thought of, but as the main power house was 2,000 feet from the river the distance would be too great for steam piping, and it would have been necessary to install a separate boiler plant near the pumps.

It was, however, perfectly feasible to transmit compressed air the required distance, and accordingly air lifts of the Ingersoll-Rand type were installed with an Imperial compressor in the power house to supply the air, and a pipe line from there to the wells.

Fig. 1 shows the essential features of the air lift installation, the view being taken from the sugar dock where the cargoes are received. In the middle foreground is a permanent cofferdam enclosure in which the six independent lifts are located. For each of the lifts a 16 in. pipe was sunk to a depth of 70 feet. The pipe when sunk to the required

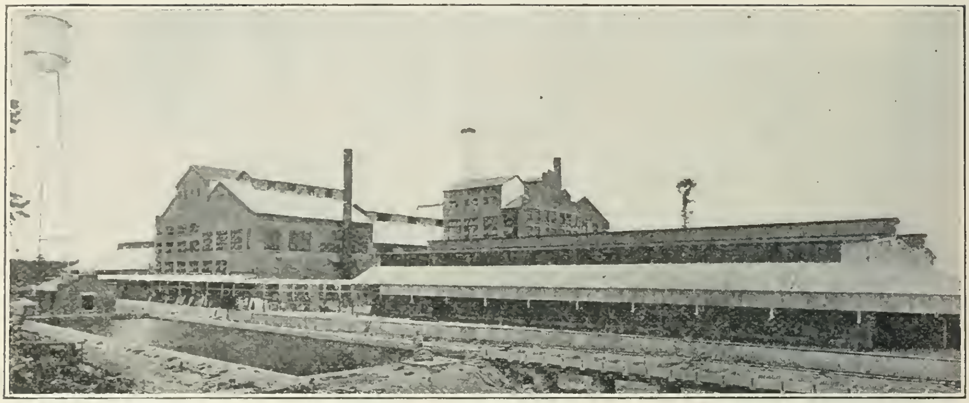


FIG. 2. FLUME AND FILTER RESERVOIRS

depth was cleared of sand and the bottom was plugged tight with a body of concrete. This then constituted a well always full of water flowing in from the bed of the river at the top of the well. Into each well was then placed and securely supported a 9 in. water delivery pipe with a foot-piece extending nearly to the bottom of the well. A 2 in. air pipe carries the air down the well, where it enters the water delivery pipe and the bubbles of air are distributed through the column of water all the way to the top thus levitating the column of water so that it continuously rises and flows away into the flume and is continuously displaced by the "solid" water of the well flowing in at the bottom. The flow continues night and day as long as the supply of air is maintained. At the right of the picture is a large air receiver to equalize slight fluctuations of air pressure. At the left end of the receiver is seen the main air pipe with the vertical pipes leading to the several wells. In each of these pipes is seen a 2 in. stop valve for controlling the flow of air or for shutting off either well, when, as is generally the case, all are not required. The flume into which the water is delivered, 12 ft. above the surface of the river, is seen extending to the extreme left of the picture, and in Fig. 2 is seen the end of the flume and one of the settling tanks into which the water is delivered.

Here the water is chemically treated to cause the settling of mud and silt, and is then pumped by steam pumps to sand filters on top of the refinery buildings. Coming out of these clear and pure it is heated and converted into vapor for the vacuum pans, and is used in large quantities for washing the boneblack through which the sugar is filtered. The water also is used for the battery of 13 steam boilers.

It will readily be seen that the air compressor which animates the air lifts is thus the heart which supplies continuous impulse to the entire establishment. It is not a formidable affair and is little suggestive of the responsibility it bears. It is an Imperial X Duplex Steam Driven Compressor with steam cylinders 12 in. diameter, air cylinders 21 in. diameter and a stroke of 16 in. It runs normally at 170 revolutions per minute, with a piston displacement or nominal free air capacity of 2171 cu. ft. per minute, at 30 lb. gage pressure.

Under the direction of Mr. O. L. Merkt, engineer in charge, the air lift system was tried one day in June and turned out within the time more than the 10,000,000 gallons of water required.

In addition to the air lift above described the engineers also sunk an artesian well 550 feet deep, with an air lift flow of 400 gallons a minute. This artesian water, which is too "hard" for boilers and vacuum pans, is used for washing the refined sugar and for drinking purposes.

The railroad connecting Chili and Bolivia, which crosses the Andes 14,105 feet above sea level, provides oxygen chambers in which passengers can get relief from the rarefied air of the high altitudes.

DRILLING FIVE-INCH HOLES FOR DAM REINFORCEMENT

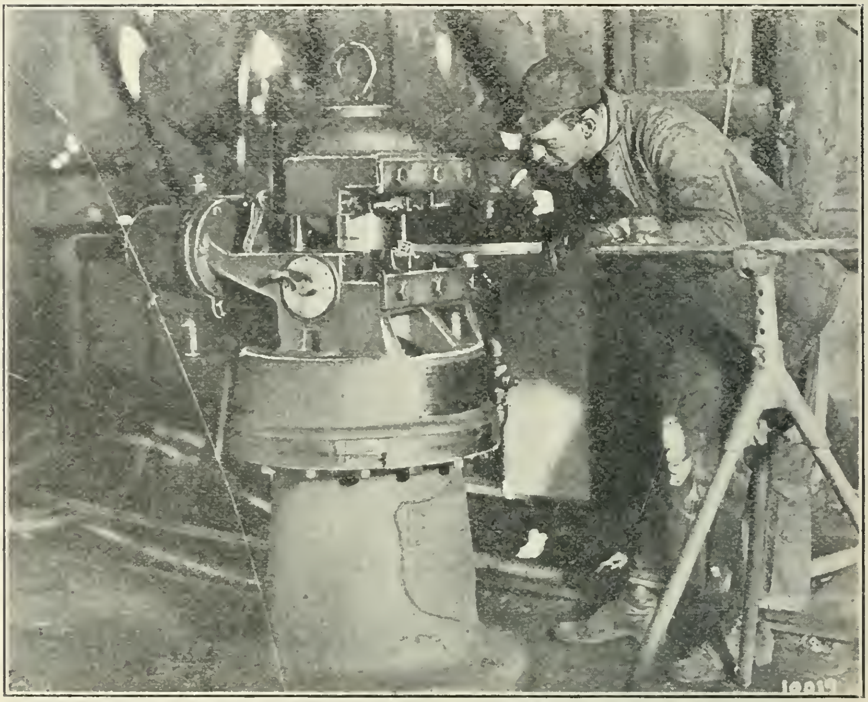
FIVE-INCH HOLES MADE WITH HAMMER DRILLS

BY H. L. HICKS

The reconstruction and enlargement of three dams at Big Creek, Fresno county, California, to provide additional storage capacity is marked by a method of anchoring the new concrete to the original reinforced-concrete structure of dam 2, which required drilling a large number of shallow, large-diameter holes.

The construction work is being conducted by the northern division of the Southern California Edison Co., whose chief engineer, R. C. Starr, devised a plan of using 6-ft. lengths of 30-lb. rail as ties, setting them vertically into the stepped back of the existing dam. This necessitated the drilling, at close intervals, of 5-in. holes 3 ft. deep. In fact, the practical success of the whole system was dependent upon the possibility of drilling with rapidity and at reasonable cost the large number of holes required.

Owing to the unhandy location of the holes



LEYNER DRILL SHARPENER AT BIG CREEK DAM

to be drilled, it was out of the question to use the heavy tripod-mounted piston drills usually employed for putting down large-diameter holes. E. L. Fox, superintendent in charge of the drilling, placed his faith in the ability of unmounted hammer drills to carry out the work, although nearly all the drill manufacturers were of the opinion that it would not be possible to handle bits as large as 5 in. in diameter because of the large number of very hard boulders which would be encountered embedded in the concrete. After experimenting with various kinds of bits and different machines, Mr. Fox finally selectel Leyner-Ingersoll drills for this heavy duty, they having shown from 30 to 40% greater speed than others.

Eight drills are in use, of the type ordinarily used in tunnel driving on a column or bar mounting. The drills have been fitted for this work with special handles and are operated by two men as hand hammer drills. Standard 1¼-in. solid round steel is used with 5-in. bits. The Leyner water-feeding device has been dispensed with and the holes are drilled dry, the cuttings being cleaned out by means of an auxiliary blowpipe. The average drilling time for a 3-ft. hole is 20 minutes.

The duty on the drills is severe, and to relieve the strain as much as possible a Leyner sharpener (Fig. 2) fitted with special dies to handle the large bits, was installed. Absolute gage perfection secured in this way relieves the drill rotation mechanism of excessive wear and has largely eliminated loss of time due to stuck steels.

When all the holes have been drilled the lengths of rail will be grouted in and the forms set for pouring the new concrete.—*Engineering News Record.*

HOW IT FEELS TO BE GASSED

BY AN ENGLISH OFFICER

"It was somewhat over a year ago that we put up four mines right under the enemy's front line. I was not in the line that night, as I had been relieved three days before, but the officers not on shift all went up to high ground a mile or so behind, and saw them go up. The drives were all in clay, and not a stick of timber put in to support either roofs or sides; 4 ft. high and 2 ft. wide, regular 'rabbitburrows,' as we call them, and we 'rushed' them at the rate of 30 ft. a day, an eight-hour shift doing 10 ft. Of course, all the dirt had to be carried out in sand bags, and put over the parapet at night. The Infantry in our lines carried out a bombing raid, but the damage done was so great that they only got three prisoners. All the enemy in the front line of that section at the time seemed to have been killed, and the trenches absolutely obliterated, so it was quite a successful 'stunt.' The prisoners say that there were over 150 men in these trenches at the time of the explosion. In one of our saps we broke into a German sap which they were working. We had interpreters down to listen to what they were saying, and one afternoon one of them came down and shouted: 'Where are you, Hans?' first in German and then in English. It rather frightened our men, till we found that they both spoke English.

"Now after an affair like that, one may expect reprisals. I reached the shaft, and met an Infantry officer who had had a look in, hearing my fellows moaning, and he and his sergeant were gassed on the first step. I posted a sentry, with orders on no account to let any one down until my return, and hurried off to get my mine rescue apparatus. The mine rescue station is about 250 yards away. I put on my set, and took the man who was in charge of the proto station (a trained man) with me; also a rope. Adjusted my gear when I reached shaft head; told the Infantry to haul when I pulled three times on the rope. The first man was in about 100 ft. I hitched the rope round him, and pulled three times. I put my hands under the man's head, to keep him from being hurt. Well, they hauled him hand over hand like a sack of coals, and I, having a proto set weighing 35 lb. on, and holding up his head and shoulders, was simply dripping with perspiration when I got to the top. I told them to go on with artificial respiration, send for an oxygen reviving set, and keep him warm. I reached No. 2, and the Infantry hauled him out carefully and slowly. No. 3 was my corporal, a great big chap with a bad cut on the head as well as gassed. But he was breathing, though 'out,' and two others were in the same condition. By this time I had used up all the oxygen in one proto set. On reaching the surface I found that three good proto men had arrived, also my Captain and another Lieutenant. We dug our man out, and I ran up to the shaft head and told them to haul when I pulled three times. We put him on to the mat and roped him in, and pulled three times, but they had got mixed up somehow, and would not start the winch; so, as I had three good proto men standing alongside me, I took the risk and pulled my mouthpiece out for just enough time to shout: 'Haul, you fools, can't you?' Directly I'd done this, I regretted it. However, they hauled, and as soon as the dead man was clear of the shaft, I sent my three men up, and followed them myself. I should have liked to have the rope down for me, but could not signal to tell them. Every rung of that ladder seemed to get bigger and bigger, till it seemed like getting my hands round a small tree, and my arms had gone stiff, so that I could not bend them at the elbow; but I got there all right, and was collared by the men at the winch as I reached the top and was just dropping off. When I got to the top of the incline I pulled myself together, and told my Captain that all the other men (six) must have been instantly killed by the shock and the fall of earth, and that it would be of no use to send any one down again till the CO gas had cleared. I got to our bottom dugout about 400 yards away somehow—with assistance. It was then dark, and I had been under since 5.15 p. m. As it was June, it would, I fancy, be nearly 10 p. m. I had enough sense to tell them to put an oxygen reviving set on my mouth, and I remember very little more till I got to the first Field Dressing Station, about a quarter or half a mile up the trench. Here I was given hot coffee, which made me very sick, and infernal smelling things were put in front of my nose. When I had more or less revived, I was taken on up the trenches. I found here the men who had been gassed, all doing well and able to speak, and they started up the trench on stretchers with me. I shall always remember that last stretch of trenches, for it was raining hard and I was so cold, and shaking with ague. CO absolutely stops one's circulation for the time; I was also very sick. So on to No. 2 Dressing Station, that is where the motor ambulances pick you up. Here my Company doctor met me, and it seemed better for me to go to the 'Savoy,' which was only 300 yards away from the top dressing station, and get warmed up with hot water bottles. So our doctor took me along in the stretcher, got my clothes off himself, and dumped me from the stretcher on to the bed without any mercy, and put two rum jars of hot water along with me. By this time it was half-past two in the morning. I slept more or less till seven, and woke up feeling quite fit.

INDUSTRIAL OXYGEN EXPLOSIONS

In the issue of Compressed Air Magazine for May, 1917, attention was called to the occurrence in California the year before of three fatal explosions of oxygen tanks within three days of each other, the cause of the explosions being the pressure of hydrogen in the tanks commingled with the oxygen. Many serious explosions from the same cause have been occurring in different parts of the country leading to various investigations. Mr. Edward K. Hammond, Associate editor of *Machinery,* has done the industrial community a valuable service in compiling up-to-date information upon this important topic, and his article is here substantially reproduced.

TWO METHODS OF OXYGEN PRODUCTION

Attention is first called to the fact that commercial oxygen is produced by two quite different processes. The first is generally known as the liquid air method, which consists of liquifying air by the application of pressure and reducing the temperature, and then separating the oxygen from the nitrogen by taking advantage of the difference in boiling points of the two liquids. Oxygen produced in this way cannot explode through the presence of impurities, because these impurities are nitrogen and other gases which are chemically inert. The second method of obtaining oxygen is by the electrolysis of water, and here there is a possibility of accidents due to hydrogen being present in sufficient quantity to make a mixture that is highly explosive. This danger is theoretical rather than practical, so long as the proper precautions are taken in the operation of electrolytic generating plants; but where there is lack of care in attending to generators or where the generators are of unsuitable design, this danger may prove serious.

RANGE OF PROPORTIONS OF EXPLOSIVE MIXTURES

Theoretically, the explosion of a mixture of hydrogen and oxygen results in the combination of two volumes of hydrogen gas with one volume of oxygen; but while this is the mixture required for a complete explosion, experience has shown that there is a wide range of mixtures that constitute what may be called a danger zone, *i. e.,* mixtures that may explode with violence under certain conditions. This question was considered of sufficient importance to warrant an investigation being undertaken at the Pittsburg Laboratory of the Bureau of Mines, where it was found that mixtures ranging from 9 per cent, of hydrogen and 91 per cent. of oxygen up to 92 per cent. of hydrogen, and 8 per cent. of oxygen were likely to give trouble. This is more liberal than limits established by the Davis-Bournonville Co., Jersey City, N. J., a well-known manufacturer of welding and cutting equipments, including oxygen generators. In this company's laboratories the danger zone was found to cover a wider range, extending from 6 per cent. of hydrogen and 94 per cent. of oxygen down to 97 per cent. of hydrogen and 3 per cent. of oxygen. The idea of this danger zone will be best understood by reference to the tabulated figures, the brackets representing the range of explosive mixtures. Here it will be evident that mixtures of hydrogen and oxygen represented by the high and low limits, and all mixtures coming between these limits, may be made to explode under suitable conditions.

Oxygen	Hydrogen
100	0
98	2
96	4
94	6
91	9
8	92
6	94
3	97
2	98
0	100

Note—Brackets inside the columns represent range of explosive mixtures, as determined by Bureau of Mines; and brackets outside the columns cover range of mixtures found to be explosive by the Davis-Bournonville Co.

CHANGES IN ELECTROLYTIC GENERATORS

Investigations conducted with the view of determining the cause of oxygen explosions that have resulted disastrously have led to certain important modifications in the design of electrolytic generators and auxiliary equipments to prevent the recurrence of such accidents. In the operation of an electrolytic cell, decomposition of water results in liberation of hydrogen at the negative electrode of the cell, while oxygen passes off from the positive electrode. The cells are so arranged that gas collected from each of these electrodes is passed into containers provided for the hydrogen and oxygen, respectively. Should it happen that the polarity of the generator is reversed, it would result in a corresponding reversal of the polarity of the cells, so that oxygen would be collected in the container provided for hydrogen, and *vice versa*.

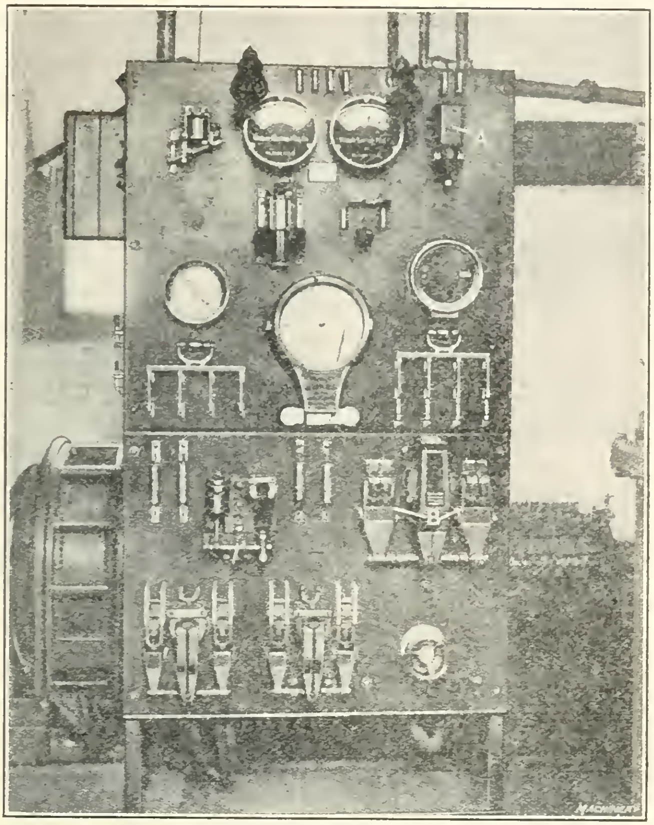


FIG. 1. SWITCHBOARD WITH AUTOMATIC SWITCH TO PREVENT REVERSAL OF POLARITY

As a matter of fact, this has been the cause of some serious accidents, and a study of the subject led to the provision of safety devices which make it impossible for trouble of this kind to occur. The safeguard consists of an automatic switch, which makes connection with the electrolytic cells only after the generator has reached normal speed and is developing its normal electromotive force. The necessity for this provision arises from the fact that at any time when the operation of a generator is stopped there is a tendency, while the armature is still turning over by inertia, for a counter-electromotive force to be built up in the cells. This may reach sufficient proportions to overcome the magnetic force of the field windings of the generator, so that when it is again started the generator will operate with its polarity the reverse of normal and supply energy of a correspondingly reversed polarity to the electrolyzers.

Should such a condition exist, it is obvious that hydrogen would be delivered to the oxygen gas-holder and oxygen to the hydrogen gas-holder, thus forming a dangerous mixture with the gas already in these holders. But with the automatic swtich referred to, there is no danger of this trouble, because the generator will have assumed a normal speed and developed its normal electromotive force before the switch can be closed to allow current to pass through the cells. This method of safeguarding the connecting of the electrolyzers to the power supply makes it impossible for a counter-electromotive force in the cells to overcome residual magnetism in the windings of the generator. In the switchboard illustrated in Fig. 1, the switch shown at *A* is for making connection between the generator and cells, and is automatically closed by magnetic coils *B* when the generator speed and voltage have reached the normal figure. When the electric generator is stopped, the circuit through the electrolytic cells is automatically broken.

To further assure against trouble from a counter-electromotive force in the electrolytic cells due to causes outside the plant, such as the reversal of phase in the motor supply circuit, transposition of connections at the electrolytic cells, etc., use is made of a polarized relay connected to a special shunt. This provides for opening a single-pole relay in the control circuit, and the only way in which this circuit may be re-established is to close the relay by hand, provided the polarity has been restored to normal. If a plant is equipped with this system of control, reversal of polarity is indicated by failure of the electrolytic cells to operate. It is important to note that the generator used in connection with electrolytic cells should be of the shunt-wound type, because with compound-wound generators there is greater danger of reversal due to the counter-electromotive force in the cells passing through the series turns.

In addition to danger of the generation of explosive mixtures of oxygen and hydrogen through a reversal of polarity of the generator, trouble may also be experienced through improper connection of the terminals of electrolytic cells. As a matter of fact, this was the cause of a serious explosion which occurred in St. Louis some time ago. With the view of preventing accidents of this kind, the Davis-Bournonville Co. and other manufacturers of electrolytic cells have designed their electrical connections in such a way that it is impossible to connect them with the wrong polarity.

FREQUENT CHEMICAL ANALYSIS

There is only one way to be sure that the purity of oxygen generated in electrolytic cells is up to the required standard, and that is by making chemical analyses at intervals of at least two hours. As a matter of fact, these analyses are simple to make and do not call for extensive technical knowledge of chemistry. Several methods are employed, the most common one being that of measuring one hundred cubic centimeters of gas into a burette, and then running this gas into another burette in which the hydrogen is burnt out by a platinum coil, which is raised to a red heat. The gas is then returned to the first burette and again measured, the contraction in volume expressed in cubic centimeters representing the percentage of hydrogen in the gas.

Other methods of determining the purity of oxygen consist of running the measured volume of gas into a second burette containing either pure metallic copper or sticks of phosphorous. Both these materials have the power to absorb oxygen from the mixture of oxygen and hydrogen, and after this absorption has been completed, the hydrogen is returned to the burette and measured. The contraction in this case represents the percentage of oxygen present. Standard apparatus can be purchased for making all these tests. In practice, it is customary to get a purity of 99.7 to 99.8 per cent. for hydrogen and a purity of about 99.5 per cent for oxygen. If the purity of hydrogen runs below 99.5 per cent. or the purity of oxygen is found to be below 99 per cent., it is considered that the generator is operating unsatisfactorily, and the man in charge of the station immediately proceeds to look for the cause. Where this precaution is taken, there is little danger of trouble from the use of electrolytic oxygen, because a high factor of safety is provided.

OIL CAUSING EXPLOSIONS

Experience has shown that in the presence of oil there is danger of an oxygen cylinder "exploding" from what may properly be termed "spontaneous combustion" of the cylinder, although the gas is pure oxygen without any trace of hydrogen. This is due to the fact that the action of oxygen under high pressure—usually about 1,800 pounds per square inch—results in oxidation of the oil, thus raising the temperature sufficiently to start the oxygen acting upon the iron cylinder, which is burnt away and allows the high-pressure gas to expand rapidly. This could not properly be called an explosion, because an explosion is usually understood to mean rapid combustion accompanied by rapid expansion. However, the condition that exists when the high-pressure oxygen is allowed to expand suddenly is similar to a true explosion, and the results have been serious in some cases. In this connection it is of interest to note that oxygen produced by the liquid air process and oxygen generated in electrolytic cells are equally likely to give trouble. Recently, the statement was made that this source of trouble could be eliminated by substituting graphite as a lubricant in place of oil, but experiments conducted by the International Oxygen Co., the Davis-Buronville Co., and others show that graphite is just as dangerous as oil.

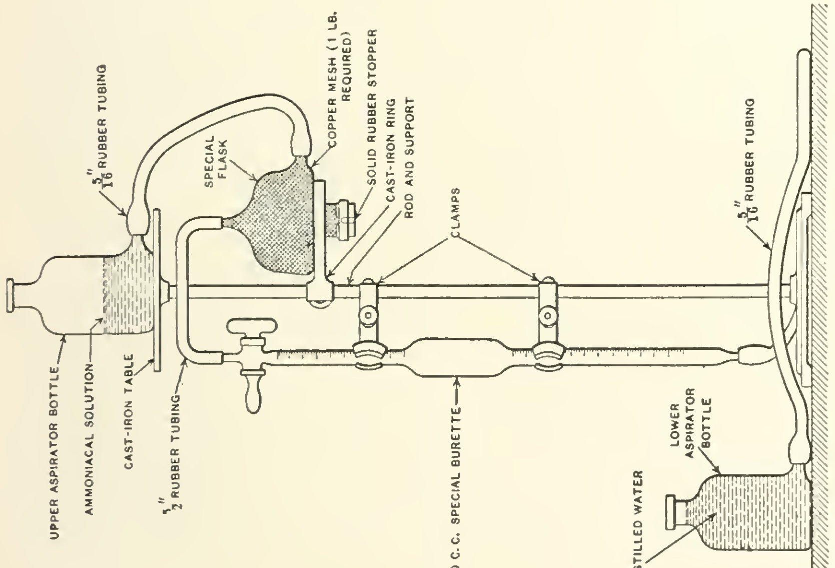


FIG. 2. FOR DETERMINING PURITY OF OXYGEN BY ABSORPTION WITH METALLIC COPPER

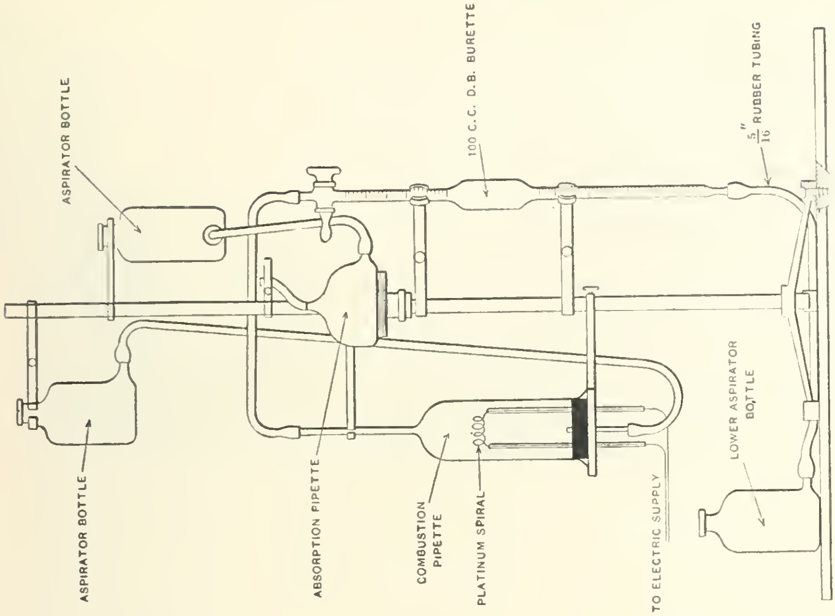


FIG. 3. FOR DETERMINING PERCENTAGE OF HYDROGEN BY COMBUSTION METHOD, AND PERCENTAGE OF OXYGEN BY ABSORPTION WITH METALLIC COPPER OR STICKS OF PHOSPHORUS

Still another hypothesis has been advanced as to a source of danger from the explosion of hydrogen. Reference has already been made to the fact that experimental data show that there must be at least 6 per cent. of hydrogen in the oxygen to make the mixture explosive. This refers to 6 per cent. of hydrogen uniformly mixed through the entire volume of oxygen. Readers of *Machinery* are doubtless familiar with the so-called kinetic theory of gases, otherwise known as the theory of uniform diffusion. According to this theory, the constituents of mixed gases are kept uniformly distributed, due to the kinetic action of molecules of the gas. For instance, a mixture of hydrogen and oxygen containing 3 per cent. of hydrogen would have the hydrogen uniformly mixed through the 97 per cent. of oxygen, and as it has already been mentioned that a minimum of 6 per cent. of hydrogen is required to make the mixture explosive, it will be apparent that there would be no danger with this gas under normal conditions.

STRATIFICATION OF THE GASES

In practice, accidents have occurred through the explosion of oxygen cylinders in which the head has been blown out of the cylinder, and investigations conducted to determine the cause of these accidents have led to the belief that under the high pressure which exists in an oxygen cylinder—amounting to approximately 1,800 pounds per square inch—the theory of uniform diffusion is not effective; it is assumed that under these conditions of pressure the gases settle out into strata, according to their specific gravities, the result being that the hydrogen rises to the top of the cylinder. This action may not be complete, but if there were a tendency for such settling out to occur, it could easily result in producing an explosive mixture of hydrogen and oxygen at the top of the cylinder, even though there were not sufficient hydrogen to make the entire mixture explosive. If such conditions can be developed, it is apparent that flashback or other cause of ignition would immediately ignite the mixture and result in the explosion of the gas in the cylinder. The theory is interesting, although it has not been definitely established by a carefully conducted scientific experiment. An accident of the same kind might also be produced through the action of oxygen on the oil used to lubricate the valve.

CAUTION IN HANDLING

In handling oxygen cylinders, it should always be borne in mind that the gas is under high pressure, and as a result it requires intelligent care to prevent accidents. Cylinders should not be dropped or handled roughly, and they should not be placed so that they can be easily overturned either by collision with some other object or by the reaction due to the violent escape of their contents through the safety outlet with which each cylinder is provided. The valve regulating devices and other attachments should not be lubricated with oil for reasons to which reference has already been made. Discharge valves should be opened slowly and special care should be taken to avoid twisting or straining the valves by the use of hammer or improper wrenches.

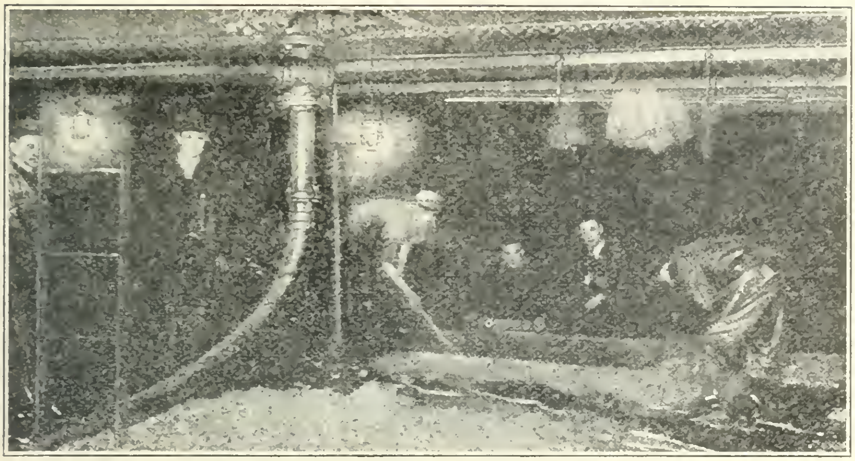
Much valuable information has been gathered by members of the Committee on Production of Electrolytic Oxygen and Hydrogen which has been appointed by the Compressed Gas Manufacturers' Association, Inc., 120 Broadway, New York City, concerning possible dangers, connected with the use of oxygen in the operation of cutting and welding torches. Distribution of information concerning the proper way to use oxygen and the safeguards that should be taken to avoid accidents will doubtless be the means of overcoming much trouble from this source.

RESPONSIBLE WORK OF A DIVING BELL

One of the great engineering works of the day, the new steamship docks at Halifax, Nova Scotia, now approaching completion, the largest docks on the American continent, costing in the aggregate $30,000,000, has perhaps not attracted the attention its magnitude and importance would seem to demand. The location of Halifax as a shipping port is unique, in that by the use of it as a point of arrival or departure the open voyage across the Atlantic is shortened by several days, varying with the speed of the vessel, and it thus becomes of supreme importance in the crowded and risky traffic of the present war. The docks in the aggregate can accommodate about fifty vessels of 7,500 tons at the same time, and two such ships as the Olympic and the Mauretania could lie end to end at one of the piers.

The design and construction of these docks had their original features carefully planned to suit the special conditions. The piers supporting the docks are based upon the underlying rock of the harbor, and consist of concrete shells 31 by 21 by 3 ft. piled one above the other to the number of 13, which brings the top three feet above high water, and surmounting this blocks of granite are placed. The shells are reinforced by steel bars in the making, and when they are in position they are locked together and the interiors of the shells are filled with concrete, also reinforced, thus forming a solid and enduring mass.

A genuine diving bell, not differing essentially from the old familiar type, is employed in clearing the surface of the rock and preparing upon it a level bed of concrete for the reception of the shells spoken of above.



WORKING CHAMBER OF DIVING BELL

The area covered by the diving bell or movable caisson is somewhat larger than the dimensions of the shells to be placed, and the height of the working chamber is sufficient to permit perfect freedom of movement. A view of the interior of this chamber with work going on is given in the halftone here reproduced from the *Scientific American*. As the face of the rock averages about 40 ft. below the water level the air pressure carried, varying with the height of the tide, has been about 20 lb. per sq. in., not enough to cause serious trouble to the workers. The diving bell is lifted and shifted from one location to another by a powerful derrick. With the diving bell not lifted out of the water, and with any desired amount of air in the chamber not much power is required for moving it.

An immense railroad area is provided for both passenger and freight service at the pier level. Although the docks are not to be completed until next year great docking facilities for both Canada and the United States are already available.

HAND-DUG OIL WELLS IN JAPAN

One who visits Higashiyama for the first time is bound to be struck with a sight which is strangely incongruous. As he ascends by a trail toward the crest of Katsubo hill, which presents a typical appearance of an up-to-date oil field, with rigs, tanks and boiler houses, he will see the flank right below the crest scattered with conical structures, closely resembling Indian tepees. These are huts built over dug wells. Existence of this primitive type of oil well in close proximity to the modern method of operation is mainly due to scarcity of fuel and absence of water sand above the pay. The well is dug by a man descending to the bottom, the chief tools being a pick and a mattock. The earth or rock dug up is hoisted out of the hole in rope nets by means of a straw rope that passes over a wooden pulley hung from a beam stretched across the hut about 10 feet above the mouth of the well The rope is pulled by three men, two standing on a shelf built in the hole about a couple of feet below the mouth.

The hole is 4 or 5 feet square and goes down 400 or 500 feet to the sand without any variation in size. The sides of the hole are timbered all the way through by driving a post in each corner to which are mortised girts to keep sheathing boards against the well. The girts also serve the purpose of a ladder for the digger in going down to the bottom.

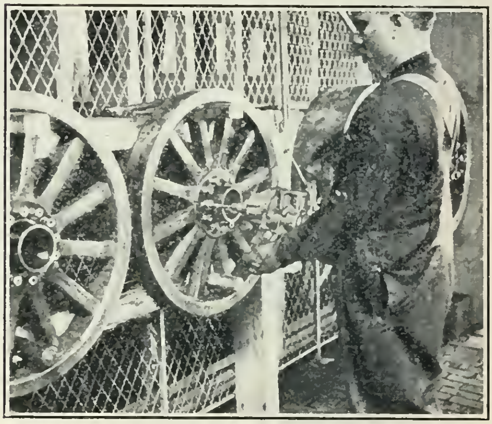
A PRIMITIVE BLOWER

The hole is ventilated by constantly sending down fresh air to the bottom by means of a treadle-bellows, which is a sort of bottomless box of oblong shape, measuring about 7 feet long by 3 feet wide and 2 deep, set on the ground at one side of the mouth of the well. The box is divided into two compartments by a board set in the middle of each longer side of the box. There is a rid or tread-board that covers the entire top of the box, snugly fitting within four sides, and balancing on the top of the dividing board which swings in see-saw fashion. A man stands on the board and walks from from one end of it to the other, alternately kicking down first one end and then the other. In each end of the board is a valve consisting of a square hole with hinged flap underneath, and when one end is kicked down the valve on the end closes up and forces the air in the compartment at that side out into a small chamber, attached to the outside of the box, inside of which there is a tongue valve that cuts off the communication with the other compartment and allows the air to rush down into an airshaft, which extends from the bottom of the chamber into the bottom of the well. As the depth of the hole increases more men are set to working the bellows, and as many as a half dozen men are sometimes seen treading on the board.

The diggers generally work in a tour of two hours each, and when the hole is making some gas or oil, the man in the bottom gets so exhausted a tthe end of the tour that he is literally dragged out by a rope that is tied to the life belt which he wears, on which occasion his life hangs on the rope and a wooden pin scarcely larger than a lead pencil which holds the sheave in the pulley over which the rope is pulled. It is strange to note that no accident has ever happened from the breaking of either the rope or the pin.

PNEUMATIC TIRES BEST

Truck manufacturers and users generally advocate the use of solid rubber tires, but evidence shows that the pneumatic tire, properly proportioned to the load, is as advantageous for trucks as for pleasure motor vehicles. The test on a Packard 1½-ton army transport truck was recently made over a distance of 4288 miles from Detroit, Mich., to the Mexican border and back. The truck was fitted with 36- by 7-inch "Nobby" tread U. S. pneumatic tires. The conclusions drawn from the trip are that an average of 40 per cent. more mileage per gallon of gasoline can be obtained from trucks equipped with pneumatic tires than from those equipped with solid tires, and that oil consumption is reduced 25 to 30 per cent. The pneumatic tires greatly reduce road shock and lower truck depreciation fully 50 per cent. The average mileage per gallon of gasoline was seven, and the lubricating oil consumption of the trip was one quart of oil per 33.42 miles.

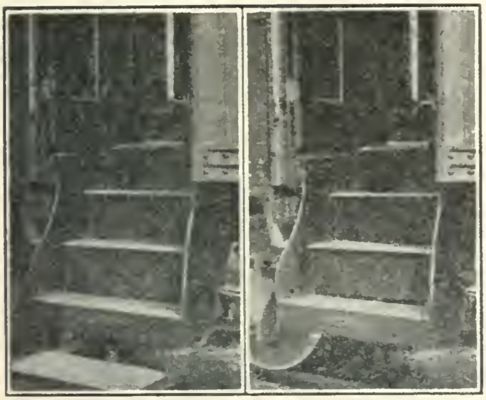


SPINNING THE NUTS ON

LITTLE DAVID QUICKER THAN MAN'S FINGERS

In modern manufacturing methods every detail of manipulation is studied with a view to quickening and cheapening the operation. The little half-tone above neatly tells a story of time saving in one simple and familiar but numerously repeated job. At the Plainfield, N. J., plant of the International Motor Company a Little David Pneumatic Drill supersedes handwork for running down and tightening the nuts on the hubs of motor truck wheels, thereby cutting down the time of assembling from 15 minutes to 2 minutes and dispensing with the services of one man of the five originally constituting the gang.

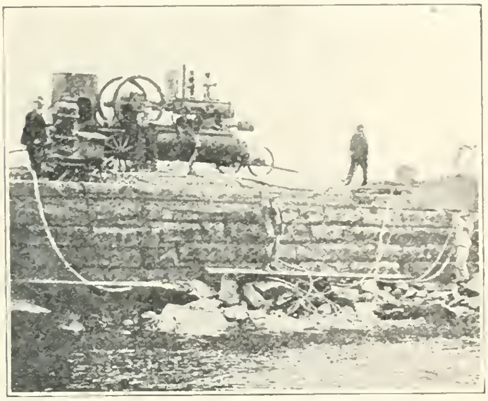
The wheels are assembled on a special bench and hung up on the three pegs here shown. One man places the nuts on and runs them down with the air drill which is provided with a special socket for the nuts, the momentum of the drill giving the necessary force for the final tightening. The weight of the drill is carried by a very flexible coil spring about 7 feet long attached to the ceiling something as bird cages are frequently hung. The length and flexibility of the spring permits the movement of the drill from one wheel to another, and as each wheel is finished the other man changes it while the men with the drill moves from wheel to wheel without interruption.



SAFETY STEP FOR RAILROAD CARS

The little halftone shows, in both positions, a pneumatically operated supplementary lower step for railroad passenger cars now being introduced by the Blake Car Step Works, Charlotte, N. C. It is intended to render unnecessary the little stool usually handled by the car porter. Advantages claimed for it are that it cannot be lowered until the car is at a standstill, and that it will return automatically to the raised position when the car starts.

When the train comes to a complete stop the conductor or porter on the train presses a foot lever or button, thus applying the air pressure to an operating cylinder which forces the step into the lower or alighting position. At the same time air is admitted to a smaller cylinder which forces a small cam down on top of the car axle. As long as the car remains at rest the step is held in the alighting position by the air pressure, but when the axle of the car turns the little cam on top of the axle is rolled off. This automatically releases the air pressure which holds the step, and the latter under the influence of a counterweight is carried back to its upper position where it is housed under the first stationary step of the car. The air pressure can also be released by the conductor by pressing a release lever in the housing of the trapdoor, and the closing of the trapdoor will accomplish the same purpose. The novel feature of the device is that it is not really left to an employee to put the step up before the train starts, as the automatic release on the axle cannot fail to take care of the step when the car moves. As the step is returned to its raised position by a counter-weight, it will not operate if the passenger has his weight on it. This avoids throwing a passenger who is trying to alight when the step starts to rise.



SEAWALL AT GOVERNOR'S ISLAND

WHAT ONLY THE CEMENT GUN COULD DO

In the seawall of Governor's Island, in New York harbor, there were many thousand feet of joints between the stones from which the mortar had disappeared, leaving open seams 1 to 1½ in. wide and from 3 in. to 3 ft. deep, and for the safety of the wall it was very necessary that the mortar or its equivalent should be replaced. Hand work could not be relied upon for placing mortar to depths exceeding 6 in., and accordingly the cement gun was employed.

The outfit, seen in the picture, comprised, besides the gun, a portable gasoline driven compressor, on which was mounted also a Gould pyramid pump. The entire gang employed comprised a compressor runner, a gunman, five to seven laborers, a horse and cart and an overseer. The rig, in 25 working days, filled 22,320 feet of joint, or 900 ft. per day, at a total cost of $2,913, or a trifle over 13 ct. per foot. Henry N. Babcock, U. S. Assistant Engineer, in Professional Memoirs," estimates this cost to have been 10 to 15 per cent. greater than it would have been in a more accessible location.

It is estimated that the average depth of the joints was 12 to 15 in., and, so far as a number of tests could determine, all joints were filled to their full depth with compact and durable mortar.

COMPARATIVE TESTS OF HAMMER DRILL BITS

An investigation has recently been made by Prof. Carroll R. Forbes and Joseph C. Barton to determine the effect of the shape of the cutting edge on the cutting speed and wearing qualities of drill bits, the results of the tests being given by them in a paper for the October meeting of the American Institute of Mining Engineers, printed in the Transactions of the Society for August, 1917. What follows is a condensation of that paper, many of the tabulated records and curves of performance being necessarily omitted.

The bits tested were those in common use, namely, the 4-point or cross bit, the 6-point bit, the Z bit and the "Carr" bit, Fig. 1. The rock in which the tests were made was the red granite from southeast Missouri. It is a coarse crystalline granite containing an unusually large amount of quartz and is extremely hard, and on account of its uniform texture is admirably adapted to this work. While tests in other rocks might show somewhat different results, nevertheless it is the opinion of the authors that the relative cutting quality inherent in the shape of the bits would be the same in all rocks. Other qualities, such as mudding freely, freedom from fitchering, etc., might make one bit more desirable that another in softer rocks.

The 4-point bits were the usual shaped bits commonly made on the Leyner sharpener with 14° taper on the wings and a 90° angle between cutting edges. Some tests were run at 85 lb. pressure with a 4-point bit made with a 5° taper on the wings. This was made by using the Carr bit die.

The 6-point bits were the usual shaped bits made on the Leyner sharpener.

The Carr bits were made with a 5° taper and an angle of 100° between cutting edges.

The Z bits were made with the regular Z-bit dolly which makes an angle of about 60° in the center and an angle of about 45° on the outer cutting edge. The center is made slightly higher than the outer edges. The Carr bit dies were used in forming Z-bits to give them a 5° taper. The Z-bit dolly was for solid steel, so it was necessary to drill out the center hole.

Several Z bits were tested at 85 lb. pressure, that were filed and hammered down, to give an angle of about 100° on the center edge and 65° on the outer edges.

The holes in the center of the bits were the ordinary size with the 4-point and 6-point and Carr bits. The hole in the Carr bit was much larger than those used in the others. A hole of the same size as in the Carr bits was used in the Z-bit.

All tests were made with an Ingersoll-Rand "Jackhamer" drill. In the "down-hole" tests the drill was weighted with a 94-lb. weight, thus insuring a constant pressure on the bit.

Most of the tests were made in vertical "up-holes." The tests consisted of drilling into a large block of granite supported on stringers over a concrete-lined pit, Fig. 2. For this work the drill was mounted on an air feed, which, however, was not large enough to produce the required pressure on the bit, so that it was necessary to counterbalance the weight of the machine by a bucket loaded with 40 lbs. of scrap iron and connected to the machine by a rope over an overhead pulley.

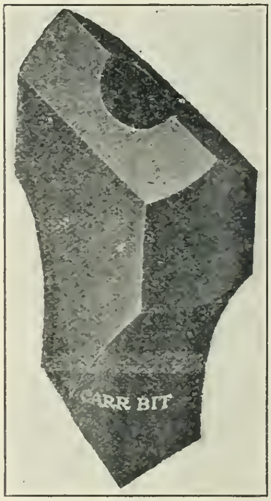


FIG. 1

Every effort was made to insure uniform conditions and to have the drill bit the only variable.

A uniform air pressure was obtained by having a "pop" valve on the air receiver, which was connected by a 1-in. hose to the drill. The air compressor was regulated to supply sufficient air to keep the pop valve open and the drill running at the same time, the gage pressure remaining constant. The air receiver was drained after every third steel, as it was found in former work that this factor greatly influenced the quality of the air supply.

Uniform lubrication was insured by oiling the drill after each 1-minute test. The

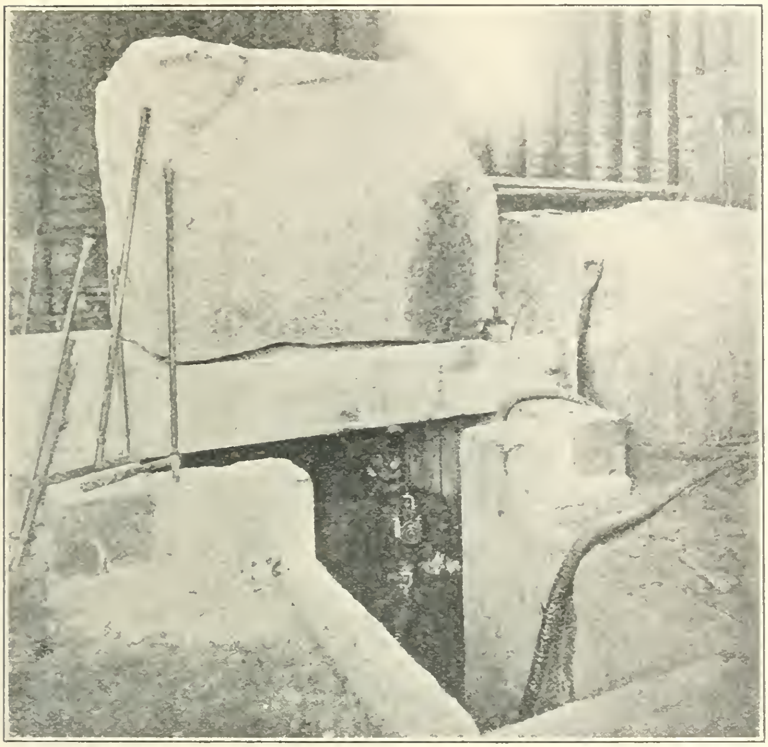


FIG. 2. WHERE THE TEST HOLES WERE DRILLED

drill was taken apart and thoroughly cleaned and oiled after every third steel.

The steel used was all of the same kind, F J A B⅞-in. hollow hexagon, and all comparative tests were run with steel of practically the same length. Lengths of 24, 48 and 62 in. were used.

MAKING AND TEMPERING THE BITS

The greatest source of error in work of this kind is in the making and tempering of bits. It is impossible to make these conditions entirely uniform and many tests were made and the results discarded, because of non-uniformity in tempering. Any bit with a corner off, or which was chipped in any way (except the Z bit in a few cases), or which showed signs of being too hard or too soft, was rejected and re-sharpened until a perfect temper was obtained.

All bits were made and sharpened in a Leyner-Ingersoll 5-A sharpener. The bits were heated, both for sharpening and tempering, in a gas muffle. In sharpening and tempering the following rules were observed: (a) Heat to the usual working heat, taking care to see that the bit is heated uniformly throughout, and making as few heats as possible. (b) Heat only the end of the bit. (c) Never submerge a bit entirely under water until cold. (d) Keep shank end square. (e) Never let scale form by too much air. (f) When worked put in lime to anneal. (g) Heat the bit up at least 800° and be sure to leave it in the furnace long enough to heat to the center; then draw from the fire and place in some dark chamber (tile, etc.), so the color can be observed, until the steel has cooled to about 800°; then dip into Sentinel paste which has melting point of 775° C., and let white residue form on the bit; place in the furnace immediately. The white residue should melt the instant the bit is inserted into the fire again; if it does not melt at once, reheat and repeat the operation.

SENTINEL PASTE

The Sentinel paste is a trade composition consisting of molecular mixtures of metallic salts which melt at predetermined temperatures. The finely ground salts are mixed with paraffin wax. Before using it is heated gently so as to just melt the wax and reduce it to the consistency of thick paint, so it can then be streaked or painted on the work in the cold, or, as in the present case, the work is covered with a thin film of paste by dipping in the paste while the work is at a temperature above the melting point of the salts. When the wax carrying the Sentinel powder burns off, it leaves behind a layer of white salt, and upon the desired temperature being attained, the salt fuses and disappears, or, on a reduction of temperature the paste reappears as a white coating. After the bit is put in the furnace and the white residue melts instantly, plunge the bit into cold water to about 1/4 to 1/2 in.

All bits in these tests were plunged into water as described above and slowly moved about in the water until fairly cool; then the steel was left in water until cold.

EXPERIMENTS WITH DOWN HOLES

The first series of tests was made in down holes. The purpose of these tests was to ascertain the effect of gage or diameter of bit on cutting speed. It was necessary to find this relation in order to compare different bits by reducing them to the same gage.

All tests were made in shallow holes, about 1 ft. in depth, so that the cuttings could be easily blown from the hole. Down-hole tests were made only with the 4-point bit and at a pressure of 95 lb. In most cases, five 1-minute runs were made with a bit. About 30 tests were made altogether.

A curve was plotted assuming that the cutting speed varies inversely as the square of the diameter. The first point on the theoretic curve was taken at gage 1.3 and speed 4.3, and the curve plotted accordingly. The results of the second test were then plotted in the same scale, the points falling close to the curve. The second tests was taken as being the most representative. Points plotted from the third and fourth tests fell close to a similar curve. In order to compare cutting speed of different gages, every condition, including depth of hole, etc., must be uniform, and it would not be fair to compare the speed of a new bit with the speed of the same bit when run to a smaller gage. From this curve it is evident that for small gages the cutting speed varies inversely as the square of the diameter of the bit. For large gages the results do not seem to check so well, and from results obtained in former work by H. Vogel, the relation of the 3/2 power was obtained, which may apply to larger gages.

RESULTS FROM UP HOLES

Three different pressures were used in drilling the up holes, 95 lb., 85 lb. and 70 lb. Most of the tests were made at the 95-lb. pressure. Nearly 200 different tests were made in all.

All holes were first collared to about 1/2 in. depth; the bit to be tested was then run at a low pressure for about 6 seconds. The bit was then taken out, the gage and the depth of hole measured, and the test was ready to start. One-minute runs by stop watch were made. All bits were run for four 1-minute tests and in a few cases six or eight 1-minute runs were made. No attempt was made to run each bit to its full extent, although in most cases at the end of four runs the cutting speed had materially diminished. The bits, however, probably would have drilled several inches farther, and in the case of the Carr bit, considerably farther. The life of bits seems to be the same at all pressures. That is, they will drill a certain distance and no more, no matter what the pressure is.

Table I represents the summary of average results and also the same average reduced, for the purpose of comparison, to uniform diameters by assuming that the cutting speed varies inversely as the square of the diameter.

It will be seen from these results that the comparative cutting speeds of the different bits at this pressure are as follows:

(1) 4-point (gage 1.75) ....2.51 in. per min.
(2) 6-point (gage 1.75) ....2.06 in. per min.
(2) Carr (gage 1.75) .....2.44 in. per min.
(3) Z (gage 1.75) ....2.13 in. per min.

At this pressure the 4-point bit cuts slightly faster than the Carr. It was very difficult to make the Z bit hold up at all on the high pressure, as the corners would invariably chip off.

Table II shows the final average of the results reduced to the three different gages by the square of diameter.

THEORY OF DRILLING ROCK

According to B. F. Tillson, "when rock is excavated by the drill bit three applications of forces seem to be involved—by abrasion, by crushing, and by severing or chipping. Although all of these must take place to a certain degree, the greatest amount of useful work is performed when the percentage of force applied to chip reaches a maximum."

TABLE I

Reduced to uniform diameters, assuming speed varies $\frac{1}{D^2}$

Kind of Bit	Reduced Gage, Inches	Average Speed Per Min., 95 Lb. P.	Average Speed Per Min., 85 Lb. P.	Average Speed Per Min., 70 Lb. P.
4-point	2.00	1.92	1.39	0.85
6-point	2.00	1.59	1.23	0.68
Carr	2.00	1.87	1.56	1.16
Z	2.00	1.63	1.51	1.16
Z flat angle	2.00	....	1.54	
4-point 5° taper	2.00	....	1.39	
4-point	1.75	2.51	1.81	1.11
6-point	1.75	2.06	1.61	0.88
Carr	1.75	2.44	2.03	1.51
Z	1.75	2.13	1.97	1.51
Z flat angle	1.75	....	2.01	
4-point 5° taper	1.75	....	1.81	
4-point	1.50	3.41	2.47	1.51
6-point	1.50	2.82	2.19	1.20
Carr	1.50	3.32	2.77	2.06
Z	1.50	2.90	2.69	2.06
Z flat angle	1.50	....	2.74	
4-point 5° taper	1.50	....	2.47	

According to this theory, the screen analysis of cutting ought to show the most efficient bit. Samples were taken from the up holes when drilling at 95 lb. pressure, from which the screen analyses were made. Screening was done in Tyler Ro-Tap apparatus. The samples were taken near the first part of a run with each bit. Some of the dust was lost in taking the sample, but as much as possible of the entire sample was saved.

The 6-point bit produced the finest cuttings, the Z bit the next finest, the Carr next and the 4-point the coarsest. This corresponds to the relative cutting speeds, the 6-point slowest, the Z next, the Carr next and 4-point fastest. In order to study further the cutting action of the different bits, four shallow holes about 1 in. deep were drilled beside each other under the same conditions and using 85 lb. pressure.[4]

A study of the bottoms of the holes revealed the fact that the 6-point hole was perfectly smooth, the 4-point nearly as smooth, the Z bit and Carr bit holes were quite rough, the Carr bit having a conical shaped projection in the center due to the large hole in the bit. The relative cutting speeds at 85 lb. pressure were as follows: 6-point, 4-point, Z and Carr, which corresponded with the apparent roughness of the bottoms of the holes.

The use of the large hole in the center of Carr bit is evidently one of its advantages and the same idea could be applied to advantage on all other bits. The advantage of the large hole is that it leaves a center core and diminishes the cutting surface.

CONCLUSIONS: COMPARATIVE MERITS OF EACH TYPE OF BIT.

Cutting Speeds.

	95 lb.	85 lb.	70 lb.
(1)....	4-point	Carr	Z bit
(2)....	Carr	Z	Carr
(3)....	Z	4-point	4-point
(4)....	6-point	6-point	6-point

From the above comparison, the 6-point bit is evidently slower drilling under all conditions. The 4-point, although ranking first at 95 lb. pressure, under ordinary conditions would drill less rapidly than either the Carr or Z. In comparison with the others, the Z bit apparently increases in cutting speed as the pressure is decreased. This would indicate that the Z bit would be quite efficient in soft

TABLE II

Reduced to uniform gages, assuming speed varies as $\frac{1}{D^2}$

Kind of Bit	Average Diam., Inches	Average Dist. Drilled	Average Speed Per Min.	Average Initial Speed	Average Final Speed	Average Loss in Gage Per Inch
A 4-point starter	1.880	8.85	2.212	2.500	1.962	0.0110
B 4-point second	1.652	11.50	2.865	3.683	2.100	0.0108
C 4-point third	1.385	15.41	3.853	4.800	3.062	0.0068
Reduced to uniform diameter						
From A	1.750	....	2.554			
From B	1.750	....	2.552			
From C	1.750	....	2.415			
	1.750	....	2.507	Average of 4-point		
A 6-point starter	1.869	7.36	1.852	2.200	1.537	0.0189
B 6-point second	1.662	10.07	2.519	2.812	2.175	0.0109
C 6-point third	1.426	10.85	2.713	3.112	2.200	0.0068
Reduced to uniform diameter						
From A	1.750	....	2.112			
From B	1.750	....	2.271			
From C	1.750	....	1.802			
	1.750	....	2.062	Average of 6-point		
A Carr bit second	1.535	12.42	3.109	4.025	2.775	0.0028
B Carr bit third	1.605	13.37	3.345	3.500	2.875	0.0032
Reduced to uniform diameter						
From A	1.750	....	2.394			
From B	1.750	....	2.488			
	1.750	....	2.441	Average Carr bit		
A Z bit second	1.609	9.72	2.429	3.275	1.925	0.0104
B Z bit third	1.447	12.87	3.212	3.850	2.600	0.0049
Reduced to uniform diameter						
From A	1.750	....	2.053			
From B	1.750	....	2.196			
	1.750	....	2.130	Average Z bit		

rock or at lower pressures, but it is evidently not adapted to extreme high pressures in hard rock. From the standpoint of cutting speed, the Carr and Z bits are the most efficient.

LOSS OF GAGE

The average loss in gage per inch was as follows:

4-point	seconds	0.010
4-point	thirds	0.007
6-point	seconds	0.010
6-point	thirds	0.007
Z bit	thirds	0.004
Carr bit	seconds	0.003
Carr bit	thirds	0.003
4-point	5° taper thirds	0.004
Z bit	filed	0.003

This loss is almost constant at all pressures. It will be seen from these figures that the loss in gage with 4 and 6-point bits is considerably more than with Z or Carr bits, and that the 5° taper on a 4-point bit greatly diminishes the loss of gage.

From the standpoint of loss of gage, the Carr, Z bit and 4-point bit with a 5° taper, are superior to others. This factor is one that is often overlooked, and the great advantage of using a bit that loses little in gage is not generally considered. As an example the following calculation has been made:

DRILLING TIME

Drilling time for 6-ft. hole in granite, 1½-in. diameter at bottom. Length of changes, 1

TABLE III

CARR

Length of Steel	1 Ft.	2 Ft.	3 Ft.	4 Ft.	5 Ft.	6 Ft.
Gage in sixteenths	1 14/16	1 13/16	1 12/16	1 11/16	1 10/16	1 9/16
Gage in tenths	1.875	1.812	1.750	1.688	1.625	1.562
Distance per minute	1.771	1.897	2.034	2.186	2.352	2.554
Minutes for each foot	7.340	6.270	5.890	5.490	5.102	4.700

Time 34 min. 49 sec. for 6 ft.

Z BIT

Gage	1.875	1.812	1.750	1.688	1.625	1.562
Distance per minute	1.723	1.839	1.978	2.126	2.295	2.484
Minutes for each foot	6.960	6.530	6.070	5.640	5.230	

Time 35 min. 16 sec. for 6 ft.

4-POINT

Gage	2 1/4	2 1/8	2	1 7/8	1 6/8	1 5/8
Distance per minute	1.009	1.230	1.389	1.580	1.814	2.104
Minutes per foot	11.890	9.760	8.640	7.590	6.620	5.700

Time 50 min. 12 sec.

6-POINT

Gage	2 1/4	2 1/8	2	1 7/8	1 6/8	1 5/8
Distance per minute	0.976	1.092	1.235	1.405	1.613	1.867
Minutes per foot	12.295	11.000	9.700	8.540	7.440	6.430

Time 55 min. 24 sec. 6-ft. hole.

ft. Difference in gages, 1/16 in. with Carr and Z bits, ⅛ in. with 4-point and 6-point bits.

From these calculations the Carr and Z bits apparently save one-third in drilling time over the 4 and 6-point bits. This is due more to the fact that smaller gages can be used than to greater cutting speed. The calculations were based on actual cutting speeds and loss in gage shown in tests.

BREAKAGE AND EASE OF SHARPENING

There is little difference between the 4-point and 6-point bits in respect to ease of sharpening and tempering.

The Z bit is more easily made, but it is very difficult to temper so that it will stand up under high pressure. This is on account of the weakness of the outer cutting edges.

The Carr bit is by far the easiest of all to make and temper and can be tempered much harder than others.

SUMMARY

The results in down holes indicate that the cutting speed varies inversely as the square of the diameter, at least for smaller gages.

Drilling speed increases almost uniformly with increase in pressure. A pressure of about 85 lb. per square inch seems to be best adapted to all bits for drilling in rock of the hardness of that used in the tests.

Speed of drilling seems to be proportional to the coarseness of the cuttings as shown by screen analysis and study of the bottoms of the drill holes.

Taking into consideration its cutting qualities, loss in gage, ease of making and tempering, the Carr bit seems to be far superior to all others, except possibly the Z when used at low pressures.

The Z bit at low pressures and probably in soft rock would equal if not surpass the Carr bit in cutting speed, but on account of the difficulty in its making and tempering, it is doubtful whether it would be as desirable under any conditions as the Carr.

For exceedingly high pressures in very

hard rock, the 4-point bit made with a 5° taper on the wings seems to be superior to all others.

The 6-point bit apparently has little to recommend it under any circumstances, although it is convenient to use in starting holes.

DRYING MONEY

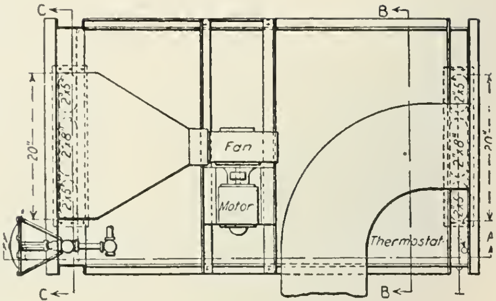
BY H. C. RUSSELL*

This paper is a brief description of the apparatus and methods used in the drying of paper currency at the Bureau of Engraving and Printing at Washington, D. C. It is with the drying of the paper on which the currency is printed that this paper deals.

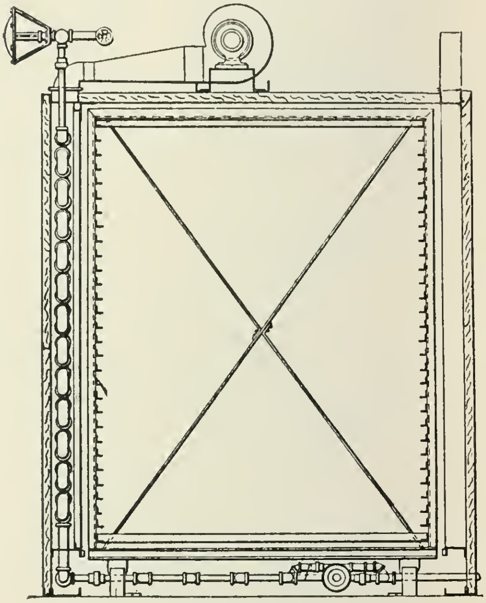
The work at the Bureau is printed on comparatively small sheets, viz: 8¼ × 13½ in. for currency and 18½ × 20¾ in. for stamps. Experience had developed a system which was perhaps unique, and which gave good results, but entailed inconveniences and discomforts.

When the new building for the Bureau was designed it was decided to have a drying room contiguous to each press room, which thus called for seven drying rooms. It was also decided to still further divide the work of drying by the use of separate closed boxes or cabinets, each to be well insulated to reduce the heating up of dry rooms in the summer. Each of these cabinets was fitted with individual steam coils, and fans heating and forcing the air through the boxes, and, as they were to be closed, a system of exhaust ducts was necessary to allow the escape of the moist air. The fans are motor driven and placed each on its own box and taking its supply from the main room, fresh air coming into the main rooms through grated transons to take its place.

Experiments to determine the size of the boxes, the amount of air necessary and its distribution, and the heating surface required, resulted in the construction of 264 boxes as here illustrated. They are essentially closets constructed of galvanized iron, insulated with 1½ in. of hair felt, the joints riveted and bolted and made tight with wood felt. They are without bottoms and are bolted to the composition floors, the joints being made with wood felt. The doors are double, two-fold, and when closed make a tight joint with the box, with each other and with the floor.



Plan of Top



Elevation A-A

FIG. I

The purpose of the insulation and the air tight construction is to prevent loss of heat from the boxes into the drying room, so that the operations of spreading work in some boxes and drying in others may proceed simultaneously without discomfort to the attendants, who are compelled to stay in the drying room while work is being spread. Some heat is necessarily radiated into the rooms, but only a small amount of the moisture laden air escapes into the rooms; a portion of the radiated heat, however, is returned to the boxes through the air supply drawn from the room.

It will be seen from Figs. 1 and 2, that the

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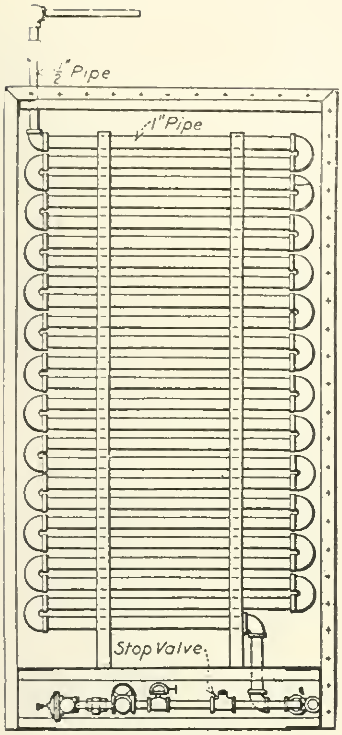
*From a paper at the summer meeting of the American Society of Heating and Ventilating Engineers, Chicago, July, 1917.



Elevation C-C

FIG. 2

fans deliver the air into the top of the box, whence it is forced downward over the coil surface and is delivered from the heating chamber into an equalizing air space, thence through a perforated diaphragm into the drying chamber, the perforations being so arranged that the air passes over and under the work in the trays. The condensation from the steam coil passes through another coil laid on the floor and is delivered through a thermastatic trap to a common condensation return main.

The trays are supported on a car or truck so that if for any reason a given box cannot be heated or fails to act, the work therein may be readily transferred to another spare box.

One of the principal advantages of the new system is that any desired temperature may be maintained in any individual box, and when the work in that box is dry the heat can be cut off without affecting other boxes. After the heat is cut off, the fans can be kept running long enough to reduce the temperature of the box to a comfortable temperature before the attendants need to enter the box. This cooling also has the effect of seasoning the paper, reducing the brittleness which is sometimes the effect of too rapid drying.

The air supply to each box is approximately 120 cu. ft. per min. According to the temperature and humidity of the air supplied to the coils, the condensation amounts to from 10 to 12 lbs. per hour for each box. The dry rooms, which adjoin the main press rooms, were designed to hold a total of 336 boxes, of which 264 were installed, leaving a slight margin for growth.

DRILL HOLES AND BLASTING CHARGES

In the rock excavation in connection with the widening of the Louisville & Portland Canal at Louisville, Ky., the proper spacing for drill holes was determined largely by trial. At first, holes were drilled at corners of 10-ft. squares, but later the dimensions of the squares was reduced to 7 ft. Even then, some pieces of the disrupted limestone were too large for the shovel dipper, and an additional hole was drilled at the intersection of the diagonals of each square and sometimes several small air-drilled holes were made through the limestone. These small holes were made by small motor-driven compressed air drills. The amount, distribution and strength of the blasting charge was determined by trial. Experiments were made, using dynamite varying in strength from 40 per cent. to 75 per cent., and concentrating the dynamite charge near the bottom of the holes, at top and bottom of holes and uniformly distributing the charge throughout the holes. The best results were obtained with the holes spaced 7 ft. in both directions and with a charge of 75 per cent. dynamite concentrated in equal amounts near the top and bottom of holes. The drill holes were carried 18 in. below grade, but in spite of this it was occasionally necessary to redrill the bed rock after blasting. With this method of drilling and charging, the amount of dynamite used, per cubic yard of rock, averaged 0.4 lb. The number of holes exploded at one blast was limited to from 10 to 15, because of complaints made by residents adjacent to the work claiming annoyance and damage from flying rock fragments.—*Engineering and Contracting.*

COAL WORKINGS TO PAY THE COST OF A BIG TUNNEL

At a recent meeting of the Mining Institute of Scotland it was proposed that a tunnel for goods and passenger traffic should be constructed under the Firth of Firth, paralleling and supplementing the well known Firth railway bridge. It did not appear that the enterprise if conducted in the usual way could be a paying proposition, but in the construction of the tunnel advantage could be taken of the special local conditions.

It appears that the work could largely be done as a coal mining operation. For a number of years miners on both sides of the Firth have been working the same seams of coal. In each case the excavations are going under the water, and as at this point the estuary is only two miles wide it would be only a question of time, under proper direction, when the two sets of miners would meet. It is computed that the work could be carried on profitably, and that the coal would more than pay for labor, materials and supervision.

QUARRYING COMPANIES IN THE BRITISH ARMY

The Director-General of Military Railways of Great Britain has recently issued a statement that it is proposed to raise ten quarrying companies for work in France in addition to those already in service there. The number of men required per company and the rate of pay are as follows: Eight foremen, ranking as corporals; pay per day, \$0.87½ to \$1.12½. Skilled quarrymen, 217, ranking as sappers; per day, \$0.55 to \$0.80. Engine drivers, 20, ranking as sappers; per day \$0.55 to \$0.80. The men should not be more than 50 years of age, and they will be engaged in quarrying roadstone in quarries which are situated well outside the danger zone. The men will be enlisted for the duration of the war, posted to the Corps of Royal Engineers, will not be armed, and their families will be entitled to the usual separation allowance.

VACCINE FOR PNEUMONIA

Among natives employed in the South African mines during the last seven years, there were over 50,000 cases of pneumonia resulting in 12,721 deaths, and the loss of over 1,000,000 working shifts. Dr. Lister, of the South African Medical Research Institute, has shown that there are several varieties of pneumococci bacillus, which causes pneumonia, and that a vaccine can be prepared which will immunise against attacks of the particular type of pneumoccocus contained in the vaccine. As the result, the Institute is now making vaccine which appears to render natives immune from infection by three strains of pneumococci, which are responsible for most of the cases of pneumonia among mine natives. Systematic tests are being carried out at the Premier diamond mine, at De Beers mine, Kimberley, and on the Crown Mines property, with distinctly promising results. The members of the Native Contingent sent to France were all inoculated with the South African Medical Research Institute vaccine, and it is said they were singularly free from pneumonia, in spite of the severity of the past winter.

RUSSIAN WEIGHTS AND MEASURES

The following table of Russian weights and measures, from an English source, will be useful in view of the big trading possibilities after the war: 1 arshine is the English equivalent of 28 in.; 3 arshines, 1 sajene, 7 ft.; 500 sajenes, 1 verst, 3,500 ft., equals 0.6628 mile; 1.508 versts, 1 English mile. Gravel measure: 1 cubic sajene in the solid, 12.7037 cubic yards; 1 doli, 0.0014 oz. troy; 96 dolis, 1 zolotnik, 2.743 dwt. troy, 0.137 oz. troy; 96 zolotniks, 1 funt, 0.903 lb. avoir., 13.166 oz. troy; 40 funts, 1 pool, 36.11 lb. avoir., 526.64 oz. troy; 100 poods, 3,611.3 lb. avoir., 52,664.5 oz, troy; 55.38 poods, 1 ton of 2,000 lb.; 62.02 poods, 1 ton of 2,240 lb.; 2,481 funts, 1 ton of 2,240 lb.; 1 zolotnik fine gold, 5.51 roubles; 1 pood fine gold, 21.160 roubles; 1 pood Lenskoie glod (average fineness), £2,001.232, equals Rs. 18,911.64; 1 zolotnik fine gold, 4.27 grams.; 1 milligram gold, Rs. 0.00129; 1 zolotnik per 100 poods, equals 2,591 dwt. per cubic yard; 1 zolotnik per cubic sajene, equals 0.216 dwt. per cubic yard; 1 oz. troy equals 7.281 zolotniks, which, at Rs. 4.92 per zolotnik at 9.45 exchange, equals £3 16s.

Statistics show that there are fewer suicides among miners than among any other class of workers.

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MAGAZINE

EVERYTHING PNEUMATIC

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THE NAVAL CONSULTING BOARD ON THE SUBMARINE

The following is a brief abstract of a Bulletin recently put out by the Naval Consulting Board of the United States and entitled "The Submarine and Kindred Problems."

The general hopelessness of employing magnetic devices for deflecting the torpedo is briefly stated, and nothing employing electricity as a principal feature should be thought of except by specialists most thoroughly informed and experienced.

What may be called the habits of the submarine are outlined as follows:

Submarines must get within close range of the victim vessel, and the arming of the latter demands for it practical invisibility.

Submarines wait for long periods in expectation of striking vessels previously determined on. They can lie at rest on the bottom if the water is less than 200 feet deep, with listening and other devices to keep them informed, and they can rise for quick observation and action if promising success.

The submarine in deep water must be kept in constant motion to maintain submergence and direction, though the speed need not exceed 4 or 5 miles an hour.

Submarines of the latest type have a surface speed of at least 17 knots and a submerged speed of probably less than 10. They probably have a total radius of action of 8,000 miles at moderate cruising speed and may remain away from any base or source of supply for a month. They may have three periscopes, two conning towers and two rapid fire guns. Gyroscopic compasses, unaffected by magnetic or other extraneous influences are used for steering.

Ready and accurate gun fire from a merchantman properly equipped makes it necessary for the submarine to take complete observations during the very brief interval occupied in coming near the surface for observation with the periscope and then immediate submergence.

If remaining near the surface, the periscope may be raised, an observation taken, and the periscope lowered again, all in 30 seconds. If the submarine is on the surface, and with hatches uncovered, from one to four minutes will be required for complete submergence.

MEANS OF DISCOVERING SUBMARINES

When the condition of sea and air are favorable a submarine is readily discernible from an aeroplane flying at sufficient height, and this has worked in the English channel and elsewhere, but the aeroplanes cannot work far out at sea without mother-ships, which are not yet provided.

Various sound recording devices, intended to locate surface vessels, submarines and even moving torpedoes are being tested.

Many optical devices are suggested, also special search lights and projectors. A moving torpedo leaves in its wake a stream of air bubbles difficult to detect in a rough sea, and these bubbles also come to the surface some appreciable time after the torpedo has passed, say 50 to 200 feet, towards its target.

The dragging of trawls or nets by special guard boats not only for locating submarines but also for floating and stationary mines has given considerable success. All the methods suggested have their limitations and inventors should apply themselves not only to the improvement of them, but also to the finding of supplementary methods and devices.

PROTECTION OF SHIPS BY NETS OR SCREENS

Many designs of such devices have been suggested, but up to the present not one has received the approval of the Navy Department or the Merchant Marine. They must be heavy, are difficult to hold in position, unmanageable in a heavy sea and interfere with the speed of the vessel and its ability to manœuver. Speed and quickness in steerage are most important protective qualities. It is noted that in no other field have so many suggestions and so many duplicate inventions been presented to the Board.

THE PROTECTION OF INVISIBILITY

The point of lookout on a submarine being close to the water, the position of a vessel at a distance can only be discovered by its smoke, so that smokeless combustion is desirable. Relative invisibility at shorter distance may also be afforded by methods of painting. The submarine has something of the advantage in the silhoueting of the object at the horizon on account of its lower point of observation. (This latter suggestion does not appear in the Bulletin).

TO DESTROY OR BLIND THE SUBMARINES

A rapid gun is effective when the submarine is seen within accurate range of the gun; but the target is so small that it is difficult to hit.

The powerful effect of any submarine explosion on all neighboring bodies provides a simple means of destroying or of crippling an under-sea boat. Once it has been even approximately located, the setting off of a heavy charge of high explosive, well submerged in the vicinity of the submarine will bring about this result. Heavy, black petroleum or similar substance upon the surface of the water, has sometimes clouded the glass of the periscope in rising out of the water so that nothing could be seen through it.

Many vessels have saved themselves from torpedo attack by a smoke screen. This may be formed by the incomplete combustion of the oil used for fuel or by burning chemicals. When enveloped in cloud the vesssel if of sufficient speed may change its direction or position with a good chance to escape.

The Bulletin gives information necessary to all would-be inventors concerning mines, floating or stationary, submarine torpedos and their manipulation.

WHY SUBMARINES CANNOT BE BLOCKADED

The submarine bases are very strongly protected by land batteries, by aeroplane observers and by large areas of thickly mined waters extending beyond the ranges of the heaviest guns. Attempts to trap the submarines going or coming are continuous, and here is presented a broad field for invention.

A GENERAL LETTER TO INVENTORS

The Naval Consulting Board is now constantly receiving so many letters of suggestions, and formal presentations of inventions of all degrees of practicability that it is found impossible to reply to them, and a formal printed letter has been prepared which covers a large number of the cases and should be satisfactory to the recipient. Perhaps the most interesting portion of this letter is the following enumeration of objections which are found to apply, one or more of them, to a large number of the propositions received.

1. It has been suggested before and, therefore, whether approved or disapproved, requires no further action.
2. A similar device is already in use by the Navy.
3. You offer a desideratum rather than an invention.
4. It is not considered practicable at present.
5. According to Naval authorities, such a device is not required.

6. Prevailing conditions render its use impossible.

7. The desired purpose is now more efficiently accomplished.

8. There is no method known at present of applying the suggestion.

9. Not practicable according to natural laws as known.

10. The facilities for construction are not available.

11. It would violate laws of war as interpreted by this country and our allies.

12. It would be too dangerous to use.

13. A similar suggestion has been tried and abandoned.

14. The proposal is not fully understood.

15. Its use would interfere with handling the ship.

16. Not practicable under marine conditions.

17. Ineffective against submarines as now built.

The purpose of the Board is distinctly to encourage rather than to discourage invention, and its purpose must be helped by these suggestions of "how not to do it."

All communications are carefully considered by a committee of six expert examiners who are all anxious to find anything that may help the cause.

"SAVING BY SCRAPPING AIR COMPRESSORS"

The following inquiry comes to us from England, "Passed by the Censor," with no hint of the address of the writer, so that we can only reply through our columns.

To the Editor of Compressed Air Magazine:

Referring to Mr. Stephen W. Symons' interesting article in your June issue, could he tell us how much the improvement was due to the new compressor and how much to the "new system of pipe lines which eliminated restricted orifices, leakages, etc." I would have scrapped the old pipe line first.

Lewis L. Kelsey.

As Mr. Symons is now serving with the British Aviation Corps it is impossible for him to reply. The problem in the above case was not to ascertain and apportion in detail the losses attributed to the compressors and to the piping system separately, both being concededly inefficient, but to replace both in the cheapest and quickest way possible. Although the old compressors were to be thrown out in any case it might have been an interesting experiment to have first reconstructed and rearranged the piping system, noting the results, but it would have taken much time, it would have entailed considerable cost, it would not have been "business."

SPECIAL AIR GIVES SPECIAL RESULTS

BY FRANK RICHARDS

[It is believed that the following, reprinted from *The Salt Lake Mining Review,* Aug. 30, 1917, is sufficiently understandable without note or comment.—Ed. C. A. M.].

"A Man Who Knows," writing in *The Salt Lake Mining Review,* July 30, uses my name at the beginning and seems to invite criticism or reply. His article, which is not long, touches the fundamental principles of air compression and seems to call for a somewhat elaborate reply which I will not attempt here. I wish now only to refer to his penultimate paragraph which it seems best to reproduce in full.

"It is a well known fact also," he says, "that the hot, *wet* air is the direct cause of the carbonization or baking of the oil in the high pressure valves, causing them to leak and very often to break. The intercooler which removes the greatest amount of water from the air before it enters the high pressure cylinder of the compressor is therefore the best one to use."

The "Man Who Knows" must certainly know, and must use in his compressors, some special brand of air which the rest of us do not know. Any air with which we are familiar, even if, as free air, it be at the saturation point with moisture, and it couldn't be wetter than that, will be *very dry air* when it is compressed to the intermediate pressure and is passed through the discharge valves of the low pressure cylinder, and of course the intercooler can have no retroactive effect up to this point.

If now this partially compressed air is passed through the most perfect intercooler in the world, which the "Man Who Knows" should know about, and if all the moisture which at this stage is possible has been taken out of it (not *all* the moisture by any means), or if the air is only passed through an ordinary intercooler such as the most experienced and successful compressor builders produce; or if, thirdly, the air is passed from the low pressure cylinder to the high pressure cylinder without going through any intercooler at all, this air when compressed to its terminal pressure and passing through the discharge valves of the high pressure cylinder will still be very dry air, dryer than at any previous point of its passage through the machine.

All this, of course, provided it is not a special brand of air which the "Man Who Knows" may know about. If the intercooler which the "Man Who Knows" knows about can get rid of "hot wet air" in the compressor at a pressure of 80 or 100 pounds he must know how the air got wet, and this knowledge may carry with it the secret also of getting the water out.

"ADVANCED FIRST AID INSTRUCTIONS FOR MINES"

The above is the title of what must be considered a most valuable handbook, or rather pocketbook, just published by the Bureau of Mines. It is prepared by a committee of surgeons: G. H. Halberstadt, A. F. Kuoefel, W. A. Lynott, W. S. Rountree and W. J. Shields, and admirably covers a much wider field than is indicated by its title. It deals not only with the treatment of all classes of accidents and disablements that may occur, but outlines generally the structure and functions of the human body and the conditions for maintaining normal health. There are 168 pages, 5¾ by 4½ inches, copiously illustrated. The paper covered edition is for free distribution and the price of the buckram-bound edition is 35 cents.

AIR NAVIGATION IN WIND, RAIN, CLOUD AND FOG

BY W. H. DINES*

A recent lecture by Lord Montagu of Beaulieu to the Aeronautical Society has directed attention to the possibility after the war of conveying mails and passengers, and perhaps goods, from place to place, by aeroplanes. In suitable weather such transit should present no difficulty save that of expense, provided that landing places can be found in such positions that the stages may not be too long, but it is obvious that the weather is, and must remain, a very important factor for many years to come.

The kinds of weather inimical to aviation are too much wind, low clouds and fog, and of these fog is perhaps the worst, as it is also in the case of shipping. The ways in which wind affects an aeroplane are various. There is the difficulty of starting and landing, but the days on which this is serious are not numerous, even in a windy country like England. But still there are days when landing is unsafe, and it is the misfortune with an aeroplane that it must in some way or other come to the earth as soon as its stock of petrol is exhausted. It cannot, like a ship outside a port with a dangerous bar, wait until conditions are more favorable; it must come down, whatever the risk. Once in the air, a steady wind has no effect upon the flying of an aeroplane, although it has a great effect upon the direction of the course. So much misapprehension exists on this point that it cannot be put too clearly. First, however, it must be stated frankly that a perfectly steady wind does not exist in practice, but the ordinary wind becomes more and more steady as the height increases, and in so far as the drift of an aeroplane is concerned it has the same effect as a steady wind of the same mean velocity.

The pilot, therefore, if the earth is hidden from him by a sheet of clouds, is absolutely and entirely ignorant of the strength and direction of the wind in which he is flying; it is just the same to him if it be a dead calm or if it be blowing at the rate of a hundred miles an hour from the east or from the west; he is, indeed, as unconscious of the motion which he is sharing with the air as he is of his daily revolution at a rate in these latitudes of some 600 miles an hour round the axis of the earth. But the effect upon the drift of his machine may be very considerable, and as he does not know what it is he cannot allow for it. The sailor also is concerned with the drift of his vessel, but he has in general a fairly good knowledge of how much it is; the currents due to the tide can be predicted, and the leeway due to wind can be estimated, but it is not so with the airman. Moreover, the rate of drift of a vessel is mostly small in comparison with her motion through the water, but in exceptional instances the velocity of the wind may equal the velocity of the aeroplane.

Thus Glasgow lies very close to a point 400 miles due north of Plymouth, and an aeroplane leaving Plymouth and flying due north at eighty miles an hour would find itself close to Glasgow in five hours' time. Should, however, a strong west wind be blowing of which the pilot did not know, and also clouds so that he could not see the earth, he would, if steering by compass, find himself in five hours' time over the North Sea, and quite possibly much nearer to the Danish than to the English coast. In the present state of our knowledge he could obtain information at starting of the general direction and strength of the wind, but not in such detail that he could hit off Glasgow within 100 or 200 miles. If he could see the ground he could ascertain that he was not traveling in the way his machine was pointing, and would thus become aware of his drift, but if he could see the ground he could steer by the known landmarks. There would be few landmarks over the sea, but the appearance of the surface should give him information as to the strength of the wind, and also of its direction.

---

*From Nature.

Hence it seems likely that in countries like England, where clouds prevail, long-distance flight, if it is to be carried on at regular times day after day, will have to be at low elevations. About 3,000 feet is the usual height of the winter cloud sheet, but it may on occasion easily descend to 2,000 feet.

Wind, therefore, though when it is steady and in a favorable direction it may be of assistance for a journey in its own direction, will in general be a hindrance to aerial navigation, and when combined with low clouds may become an insuperable hindrance. In cases where its velocity and direction can be accurately foretold, the difficulty about allowing for the drift can be overcome, but such precise forecast is not yet practicable.

A gusty wind introduces difficulties of its own; the so-called holes in the air, of which one heard so much in the early days of aviation, were due to gustiness, but greater stability and speed in the machine are eliminating these difficulties.

Clouds introduce a difficulty of their own, apart from the point that has been already considered. It would seem at first sight as though a man would retain his sense of the vertical direction in any circumstances, but this is not so. Were a man placed inside a hollow vessel that was falling freely without air resistance, he would be entirely without sense of weight or direction, and the pilot of an aeroplane in an extensive mass of cloud is in much the same position. He cannot see any definite object, and apart from sight his sense of direction depends upon the reaction between him and the seat he is sitting on. So long as the motion is uniform this reaction is vertical, but any acceleration of the machine alters the direction and intensity of the reaction, and so confuses the sense of level. The same effect is produced upon a spirit-level or similar instrument, and so confusing is the effect that it is said the machine may almost be upside down without the pilot knowing it. It would seem as though a gyroscope might to some extent meet the difficulty. One result of this uncertainty of level is that astronomical observations for the determination of latitude and longitude are not possible unless the horizon can be seen, and thus the amount of the error produced by want of knowledge of the drift cannot be known.

Fog is to all intents and purposes simply a cloud touching the earth. Landing places for aviators have naturally been put in low, sheltered positions, partly because a shelter from wind is required, but probably because more or less of a dead level is necessary, and such flat places are more likely to be found at low altitudes. Such positions are especially liable to fog. The danger of a fog lies in its concealing the landing place and hiding from the pilot until the last moment his distance from the ground.

Thus it appears that the demand of the airman on the meteorologist is that he shall be able to forecast wind and fog, and, to a less extent, clouds, on the route the airman is proposing to follow. It has long been the business of the Meteorological Office to forecast wind, and a certain amount of precision has been attained. During last winter Major Taylor investigated the possibility of forecasting fog, and gave the results in lectures to the Royal Meteorological and Aeronautical Societies. His work constitutes a considerable advance investigation of this difficult subject. If we express the wind in terms of its two components, W. to E. and S.

to N., the probable error of a forecast for each component is perhaps about ten miles an hour, and there is not much prospect of improving this; the estimate is for England and the Continent, but farther south the conditions are much better.

I do not wish to emphasize the difficulties which lie in the way of regular air services, but they are there, and the first step towards overcoming them is to admit their existence.

NOTES

In 33 years the production of iron in the United States has increased 337 per cent., petroleum, 391 per cent.; copper, 1,200 per cent.; cement, 2,087 per cent.; lead, 125 per cent., and zinc, 638 per cent. During the same period, the production of coal has more than trebled.

The State Highway Department of Missouri in a recent bulletin suggests that mudholes sometimes can be remedied by drilling down 4 or 5 ft. and putting in a shot of dynamite to loosen the subsoil and provide underdrainage.

Users of fuel oil in Buenos Ayres are burning rafaelita, a dry form of petroleum found in the provinces of Patagonia, Mendoza, and Neuquen, to help meet the present shortage of that product. Of late the burning of rafaelita has increased very greatly and helps materially to lower cost of fuel charges.

According to figures recently published, some six million shells were used in the operations that resulted in the capture of Messines. Reckoning these at an average weight of slightly over 100 lb.—probably the average was higher—this would represent a consumption of about 300,000 tons of steel.

A Permanent Aircraft Exhibit is to be established in Washington in the immediate future, under the auspices of the National Advisory Committee for Aeronautics and the Aircraft Production Board. The exhibit will include all kinds of aircraft material, engine parts, sections of planes, etc., both American and foreign, and the aim will be to make it representative of the latest developments of aeronautics. The principal object of this undertaking is to familiarize American aircraft builders and engineers with the newest and best features of aircraft construction.

The Caproni triplanes now appearing in Italy are capable of carrying 25 passengers each. They already hold a number of world-records, including the useful weight carried —nearly five tons—the speed record of 157 miles per hour, and the distance record of a run of 920 miles in 10 hours without stop. They are equipped with three motors of 700 h.p. each.

Through the cooperation of manufacturers of steel plates or shapes, manufacturers of electric spot-welding apparatus, and the United States Bureau of Standards, a program for the investigation of spot-welded joints has been undertaken. This work will be done to show the practicability of substituting spot welding for riveting in the assembling of steel structures of various types.

The Denver Tramway is making use of a 50-ft. Westinghouse air compressor, mounted on skids for supplying air for track tamping. The compressor is motor driven from the trolley supply current and is of sufficient capacity to take care of four tampers at a time. The company has been using two tampers and has been able to accomplish as much work with the two men as twelve men could do with manual tamping.

In describing the work of the airmen at the front, Major L. W. B. Rees of the British flying corps, stated recently that the British fly on three levels with three kinds of machines. The lowest are the artillery directors, who circle about in big figure eights some 6,000 feet above the enemy trenches and flash back directions to the British gunners by wireless. Above them at 10,000 feet, are the heavy fighters with two men to a machine and able to keep the air for four hours at a speed of 110 miles per hour. At a height of 15,000 feet are the single-man, light fighters, capable of 130 miles an hour and of ascending the first 10,000 feet in ten minutes.

Tentative arrangements have been made for financing a new railway in Northern Peru, which, when completed, should open up one of the richest sections of South America. The line as projected will be about 250 miles long, and will be another link in the Pan-American transcontinental system. The road will cross the lowest depression of the Andes, and on the Pacific it will have what is said to be the best seaport in South America, at Payta. Thence it will extend inland, traversing the richest regions of the Americas. The railway will put Lima, the capital of Peru, within five days of Iquitos, the head of the rubber industry of the Amazon. The trip from Lima to Iquitos cannot now be made in less than sixty days. It will put New York City within ten to eleven days of Iquitos, as compared with about thirty-five days at present.

A very remarkable trolley accident recently occurred in New Zealand on the Otira Railway tunnel, in course of construction. Four men on a trolley entered the tunnel, which has a down gradient of 1 in 33. After the party had travelled a short distance their acetylene light was extinguished, and in the darkness the trolley got out of control, and acquired a great speed. Two of the men managed to jump off before the trolley gathered way, but the two who remained were threatened with certain death. The pumps in the tunnel, however, were not working, and the end formed a "pocket" filled with water. This acted as a buffer when the trolley dashed into it. The two men were thrown into the water, where they remained shoulder deep for some time. Darkness rendered their rescue difficult, but it was safely accomplished. They were much exhausted, but unhurt.

What is claimed as the tallest chimney in the world was recently completed for a copper smelter at Sagonoseki, Japan. It is constructed of concrete, 570 ft. high, 26¼ ft. inside diameter at the top, and 42 ft. in diameter at the base. The great height was decided on to carry the fumes from the smelter to an altitude that will avoid killing the surrounding vegetation. The foundation, which is 95 ft. in diameter, contains 2,700 cub. yards of concrete. For 150 ft. the chimney is reinforced by a concrete lining, separated from the outer shell by a 5-ft. air space. The opening at the base is 31 ft. high and 20 ft. wide. The flue connecting the furnaces and chimney is 30 ft. in diameter, and 2,500 ft. long, and is provided with openings for cleaning. In the construction of the chimney 400 tons of steel was used.

According to the *Frankfurter Zeitung*, the newly manufactured compressed cellulose piping has proved very satisfactory in chemical factories and also in mining works. The new material, it is said, is absolutely non-porous, is considerably lighter than iron, can be worked like wood, and is consequently easily moved and repaired. As cellulose is a bad conductor of heat, it requires no particular protection against heat; it also resists chemical influences better than iron. Cellulose tubes are suitable for conducting hot and cold air, and for corrosive gases which eat into iron conductors very quickly. They are not suitable, however, for steam.

LATEST U. S. PATENTS

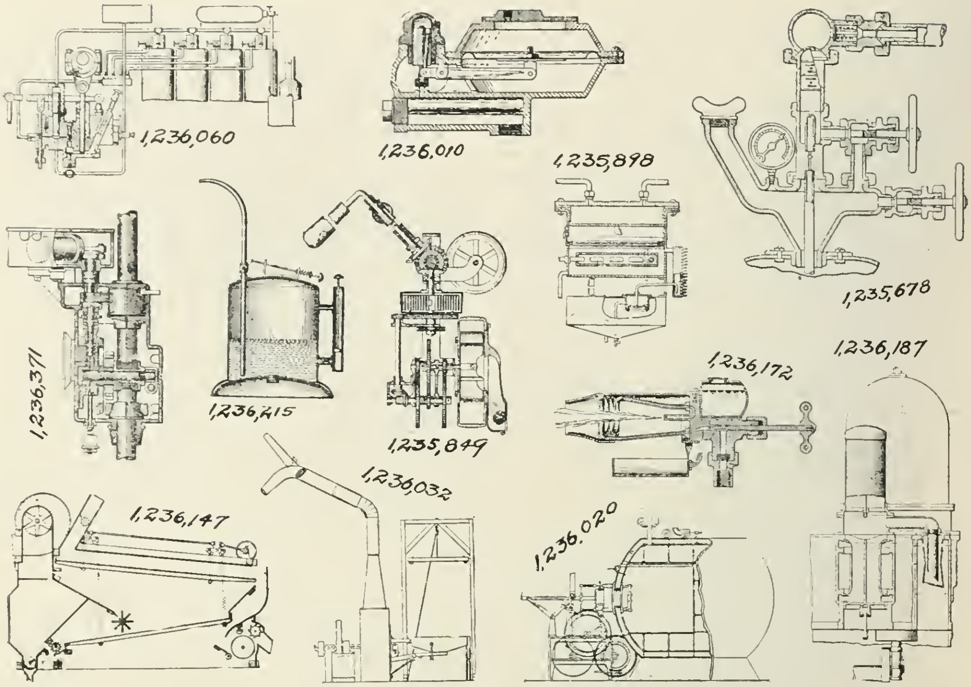
Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

AUGUST 7.

1,235,678. FUEL-OIL OUTSIDE ATOMIZER. Paul L. Geer, San Jose, Cal.
1,235,759. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. Ralph G. Benson, Chicago, Ill.
1,235,761. ELECTRIC AIR-HEATER. Carl O. Bergstrom, Boston, Mass.
1,235,849. VACUUM-CLEANER. Ezra B. Smith, Chicago, Ill.
1,235,898. DEVICE FOR WITHDRAWING AND SEPARATING THE LIQUID CONTENTS OF THE CRANK-CASE OF AN INTERNAL-COMBUSTION ENGINE. Webb Jay, Chicago, Ill.
1,236,010. HIGH PRESSURE GAS REGULATOR. G. W. Savage, Chester, Pa.
1,236,020. APPARATUS FOR GENERATING POWER. Washington B. Vanderlip, Oakland, Cal.
1,236,032. PNEUMATIC GRAIN-ELEVATOR. John R. Wright, Wheeling, Mo.
1,236,060. FUEL-SUPPLY SYSTEM FOR INTERNAL-COMBUSTION ENGINES. Gregory Caldwell Davison, New London, Conn.
1,236,147. COTTON-SEED CLEANER. James H. Cary, Memphis, Tenn.
1,236,172. BLOW-TORCH. Gustaf E. Holmgren, Duluth, Minn.
1,236,187. AIR-COMPRESSOR FOR INTERNAL-COMBUSTION ENGINES. Hermann Lemp, Erie, Pa.
1,236,215. AIR-FED OILER. Henry Schade, Shelby, Iowa.
1,236,241. APPARATUS FOR DRAWING GLASS CYLINDERS. William Westbury Okmulgee, Okla.
1,236,371. DRILLING APPARATUS. Georg H. Gilman, Claremont, N. H.

AUGUST 14.

1,236,413. APPARATUS FOR MILKING COWS. Henry Droutledge, Auckland, New Zealand.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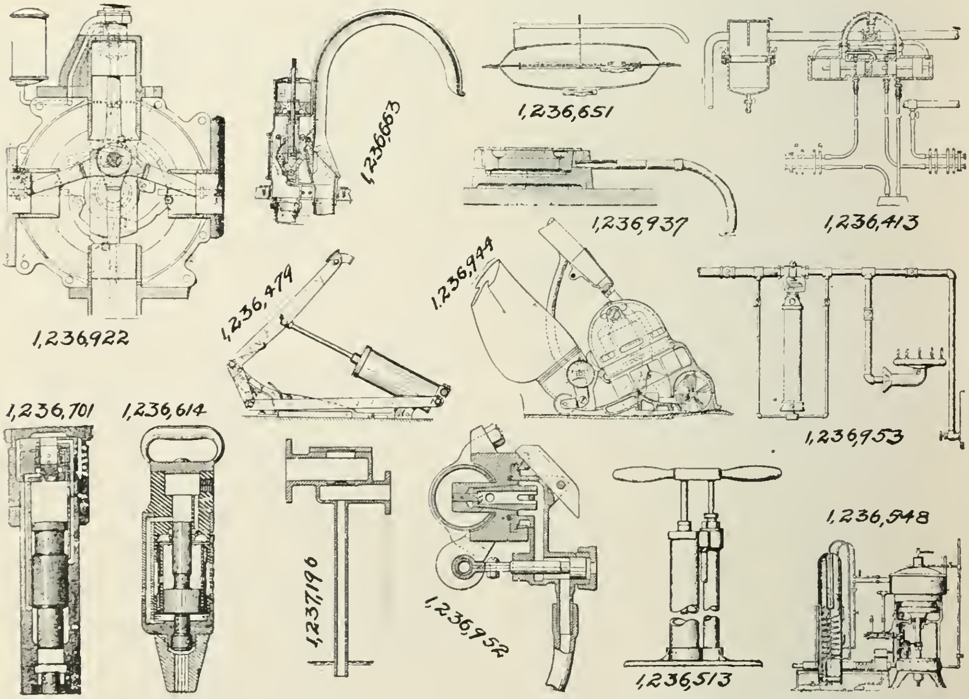
Pneumatic Patents August 7


1,236,922
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1,236,944
1,236,953
1,236,701
1,236,614
1,237,190
1,236,952
1,236,513
1,236,548

Pneumatic Patents August 14

1,236,431. APPARATUS FOR MILKING CATTLE. Charles Gilbert Hawley, Chicago, Ill.

1,236,479. TIRE - PUMP. Adolph Peteler, Freeport, N. Y.

1,236,513. TIRE-PUMP. William U. Watson, Chicago, Ill.

1,236,548. APPARATUS FOR TREATING MILK. William J. Davis and Lars Johnson, Chicago, Ill.

1,236,614. EXHAUST - CONTROLLING VALVE FOR PERCUSSIVE TOOLS. Fred M. Slater, Easton, Pa.

1,236,651. PNEUMATIC PUMP. Eugene L. Arnott and John S. Arnott, Greenfield, Ohio.

1,236,663. PNEUMATIC-DESPATCH - TUBE APPARATUS. Walter Bixby, Dorchester, Mass.

1,236,701-2-3-4. PNEUMATIC TOOL. George H. Gilman, Claremont, N. H.

1,236,922. PNEUMATIC ENGINE OR MOTOR. Harry Gibbs, Higher Tranmere, England.

1,236,937. METHOD OF AND MEANS FOR FORMING GLASS ARTICLES. William S. Hough, Jr., St. Catherines, Ontario, Canada.

1,236,944. VACUUM CLEANING-MACHINE. James B. Kirby, Cleveland, Ohio.

1,236,952. MILKING - MACHINE. Meredith Leitch, Poughkeepsie, N. Y.

1,236,953. AUTOMATIC REGULATOR FOR GAS SYSTEMS. Herbert F. Lewis, Philadelphia, Pa.

1,237,196. HYDRAULIC MEANS FOR COMPRESSING GASES. Kenneth Gauldie, Glasgow, Scotland.

1,237,210. METHOD OF PRODUCING VACUUMS. Irving Langusier, Schenectady, N. Y.

2. The method of producing high vacua which consists in reducing the gaseous pressure in the space to be evacuated until the atmosphere in said space has become highly attenuated and then vaporizing metallic tungsten in said space to combine with residual gases.

1,237,212. BLOWER. Abraham L. Loewen, Hillsboro, Kans.

AUGUST 21.

1,237,308. COMPRESSED - AIR WATER-RAISING APPARATUS. Christian De Preville, Paris, France.

1,237,335. GOVERNOR-ACTUATED FLUID-CONTROLLER. Frank Hennebohle, Chicago, Ill.

1,237,338. PNEUMATICALLY - OPERATED WINDOW-CLEANER. Frederic W. Hogg, The Dalles, Oreg.

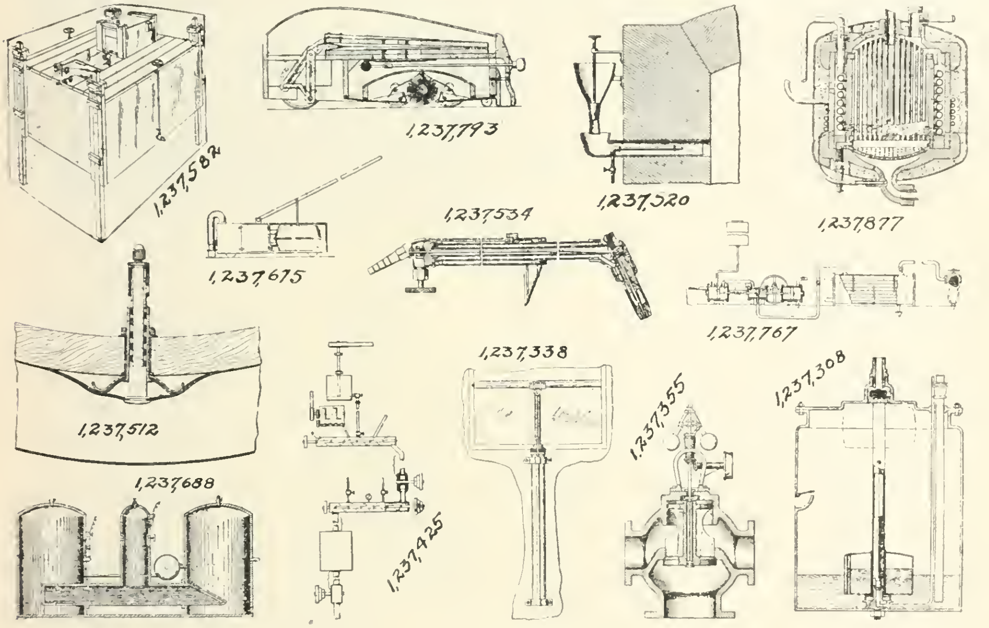
1,237,425. METHOD OF TREATING WHEAT. Arnold C. von Hagen, Kansas City, Mo.

1. The process which consists in treating grain first by subjecting the same to moisture, then agitating the grain to distribute the moisture over the shells of the grain, and then by a separate operation forcing the moisture into the shell of the grain by pressure.

1,237,512. PNEUMATIC-TIRE PRESSURE-GAGE. Charles Harrison and Kenneth Lamond, Vancouver, British Columbia, Canada.

1,237,520. METHOD AND MEANS FOR COATING KILN-BAKED ARTICLES. John W. Ivery, Brazil, Ind.

1. The method of coating kiln-baked articles during the baking operation, consisting in inducing a current of atmospheric air through a passage by a fluid pressure blast and blowing said air into the upper portion of the kiln by such blast, and in introducing the glazing material into said passage, whereby free mixing of said material with the currents passing through the passage is effected, and whereby said currents will discharge said material into the kiln in the form of a cloud.



PNEUMATIC PATENTS AUGUST 21

1,237,534-5. CUTTING OR WELDING BLOWPIPE. Edgar C. Martin, Central, S. C.

1,237,582. APPARATUS UTILIZED IN SUBAQUEOUS BUILDING CONSTRUCTION. John Taylor, Hamilton, Ontario, Canada.

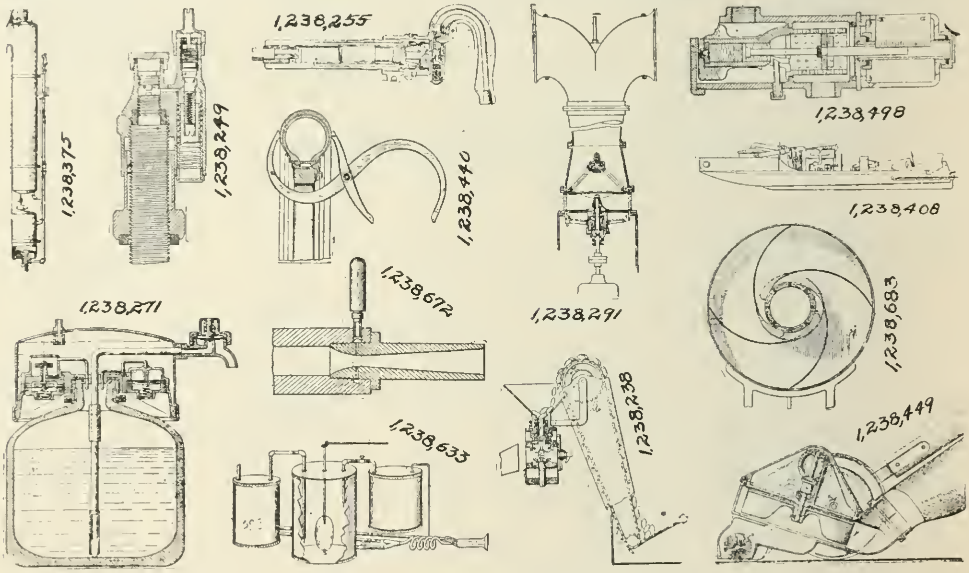
1. A device of the class described comprising a working chamber open at the bottom and adapted to be lowered over subaqueous construction, ballast tanks mounted on the working chamber and open to the atmosphere on the top, and means for alternately filling and emptying the tanks with water ballast without the use of pumps.

1,237,675. SUCTION CLEANING - MACHINE. David P. Moore and Samuel B. Pack, Washington, D. C.

1,237,688. EXPLOSIVE METHOD OF GENERATING POWER. Pontus Ostenberg, Los Gatos, Cal.

1,237,767. PROCESS OF PURIFYING GAS. Willard O. Felt, Brooklyn, N. Y.

1. A process of the nature disclosed, which comprises compressing to a pressure of approximately 300 pounds per square inch a fluid mixture comprising a gas, mixing said mixture with glycerin while under compression, and reducing the temperature of the resultant mixture to approximately 60 degrees F. while under compression, thereby separating glycerin and contained impurities and liberating the gas in a relatively purified condition.



Pneumatic Patents August 28

1,237,793. SUCTION - SWEEPER. Edward Krantz, Chicago, Ill.

1,237,877. GENERATION OF PRESSURE. Josiah Dow, Philadelphia, Pa.

1. As an improvement in the art of generating pressure from a combustible fluid, the mode herein described which consists in delivering to a combustion chamber under pressure a mixture of combustible fluid and air, directing the products of combustion first forwardly, then rearwardly, and then again forwardly, and during their second forward excursion subjecting them to the action of the products of combustion during their first forward excursion, and adding water to the products of combustion at an intermediate stage of their travel.

AUGUST 28.

1,238,101. PROCESS OF MAKING PLASTIC LUBRICATING COMPOUNDS. Eli F. Burch, Laurel Springs, N. J.

1. The process of preparing a lubricant, which consists in mixing an asphaltic oil and a paraffin oil, the latter having approximately the physical properties of dodecane, then heating the mixture to a temperature of approximately 400 degrees F. to 450 degrees F and blowing through the heated mixture.

1,238,238. NUT-CRACKING MACHINE. Dick B. Williams, New Orleans, La.

6. A nut cracking machine including shell cracking mechanism, and an air blast ejector device having an intermittently-operative blast and a constantly-operative blast.

1,138,249. AIR-PRESSURE GAGE. Sherman S. Benson, York, Nebr.

1,238,255. OPEN GRIP-HANDLE, INSIDE-TRIGGER PNEUMATIC TOOL. Mathew J. Burkel, Aurora, Ill.

1,238,271. SIPHON-HEAD. Paul Crovo, Carlstadt, N. J.

1,238,291. SIREN. Harry C. Heath, San Francisco, Cal.

1,238,375. AIR-BRAKE ATTACHMENT. Abbott L. Wright, Chicago, Ill.

1,238,408. PNEUMATICALLY - PROPELLED HYDRO-PLANE. Ray E. Kellogg, Los Angeles, Cal.

1,238,440. PNEUMATIC - TIRE CALIPERS. Albert O. Running, Hawkins, Wis.

1,238,449. SUCTION-CLEANER. William E. Sherbondy, Cleveland, Ohio.

1,238,498. FLUID-METER. Clarence A. Dawley, Plainfield, N. J.

1,238,633. FUEL-FEEDING SYSTEM. Frank Caldwell, Cincinnati, Ohio.

4. In an apparatus of the character described, the combination of means for churning air and oil, independent pipes for supplying air under pressure, means for mixing the churned air and oil with the air from one of said supply pipes, and a discharging element having means for delivering the mixture with the air from the other supply pipe.

1,238,672. FLUID - PRESSURE NOZZLE. John M. Hopwood, Pittsburgh, Pa.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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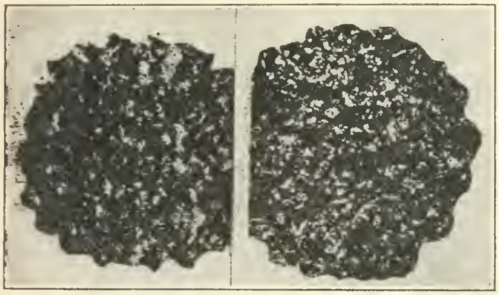

NEW SAND USED SAND

SAND BLAST PRACTICE

BY DAVID EVANS*

As everyone connected with the foundry industry knows, sand blasting is a method of applying sand under air pressure to rough castings to remove the dirt and scale as they come from the foundry.

Sand-blasting should be, and usually is, the first work done on a rough casting preparatory to chipping and grinding. The sand-blast operation, therefore, should be done at a point on the line of route between the molding floor and the cleaning room.

THE SAND MUST BE DRY

Some of the earlier attempts to use sand as a cleaning agent called for the employment of live steam in place of air. This method was said to be effective for cleaning certain kinds of castings for plating, but it made a very dirty and disagreeable job and was abandoned after a short time. This attempt to use live steam is interesting because in modern practice nothing causes so much trouble in the operation of the sand-blast as moisture. Regardless of the method or the type of machine used, or the grade of sand, care must be taken that the sand is "bone-dry" when it is charged into the machine and that no moisture created by the condensation of the air in the pipe line be permitted to come into contact with the sand, as it will choke up the machine, or at best will cause a pulsating effect instead of a steady, even flow.

AIR PRESSURE

For cleaning non-ferrous metals and for malleable and cast iron, a lower air pressure and a finer grade of sand may be used than for steeel. Steel castings are difficult to clean. The metal is poured at a high temperature, and the molding sand burns in so that the only effective method of cleaning is by a sand-blast using air at a pressure of about 80 lb. High pressure, although costing more to produce, is invariably recommended for steel castings and, reckoned by the saving in time and the increase in work accomplished, is really cheaper in the long run. It has been estimated by some engineers that it costs about 15 per cent. more to deliver air to the machine at 80 lb. than at 35 to 40 lb., but that the air at 80-lb. pressure strikes a 44 per cent harder blow, resulting in saving of time, and consequently an increase of work of about the same per cent, leaving a net saving in favor of the higher pressure machine of 25 per cent. There is a further benefit in using higher pressure in that it requires a smaller volume of sand, and consequently creates a smaller volume of dust, which must be handled and eliminated, so that the saving in the use of the sand itself and the less amount of dust to be handled are both proper credits in favor of the high pressure.

FOUR FAMILIAR TYPES OF EQUIPMENT

There are several different methods of sand-

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*President and Treasurer Chicago Steel Foundry Company. Article reprinted from *Iron Age,* Sept. 20, 1917, with some curtailment.

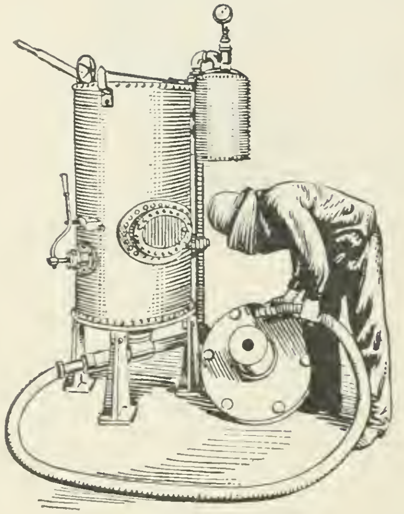

FIG. 1. USE OF HOSE

blasting, and a different type of equipment for each method as follows:

Sand-blast hose machine
Sand-blast table
Sand-blast tumbling mill
Sand-blast room

In considering the installation of a system for any particular plant, special attention must be given to the quantity and character of the work turned out in order to select the equipment best adapted. A steel foundry turning out as small a quantity as 3 tons per day needs a sand-blast just as much as a plant turning out ten times that amount, and for small plants where the volume of work does not justify a heavy outlay for equipment, the sand-blast hose machine is very satisfactory. This type of machine, Figs. 1 and 2 is common, and most foundrymen are so familiar with it that a detailed description is hardly necessary. Because of its flexibility, i. e., the capability of being used on any class of work, it is still a favorite in its modern form where the work is of a miscellaneous character.

THE NOZZLE

The part which receives the greatest wear and which requires the most frequent replacement is the nozzle. Our first experience in sand-blasting was with a machine of this type, and we were able to effect a great saving in the cost of nozzles by designing a single piece to take the place of the three-piece nozzle furnished by the manufacturer. This single-piece nozzle is cast of hard manganese steel with flat threads on the neck to fit the inside surface of the hose. The hole is tapered, the end within the hose being but a thin shell to offer as little resistance as possible to the sand. About twenty are cast on one gate, and they are broken off by the workman as he needs them. The action of the sand very soon increases the diameter of the hole to such an extent that it will consume twice the amount of air that it is intended to use. These nozzles require changing once or twice a day, and the changes are made by the operator within a very short time. This is a very important point, as the plant may provide 100 cu. ft. of air per minute for a small sand-blast hose machine and find that it uses 200 cu. ft. because of a worn-out nozzle.

THE ROTATING TABLE

The sand-blast table, Fig. 4, consists of a circular, grated disk in a horizontal position. Compressed air, preferably at 80 lb. or more pressure, carries the abrasive and discharges it through one or more nozzles upon the work resting on the disk. When one side of the work is cleaned, the casting is turned over so that it can be blasted on the opposite side. The nozzles are placed to discharge the abrasive at an angle from the vertical so that the sides and top of the casting are cleaned at the same

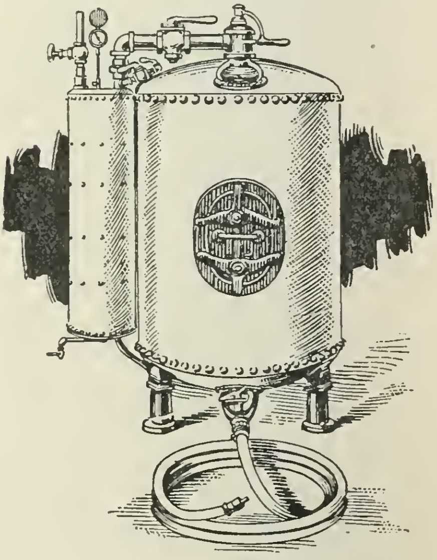

FIG. 2. COMPLETE HOSE EQUIPMENT

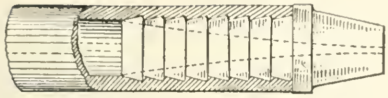

FIG. 3. ONE PIECE NOZZLE. MANGANESE BRONZE

time. This type of equipment is especially adapted for cleaning flat work, but is by no means limited to any particular kind of casting as it compares with the sand-blast tumbling mill in the variety of work it will handle.

THE TUMBLING MILL

The sand-blast tumbling mill is entirely automatic in its action and is especially adapted to handle small or medium parts of more or less irregular design. There are at least two types of this mill on the market; one of them horizontal and one tilted, Figs. 5 and 6. The object of having the barrel tilted is to impart a dual motion to the castings as the barrel rotates, so that every part will come into contact with the stream of sand, which enters through suitable nozzles located in the stationary head and, together with the dust and dirt from the castings, is exhausted through the lower end. The same theory is used in the horizontal mill by having false heads located inside of the stationary heads which give a lateral as well as a horizontal motion to the castings.

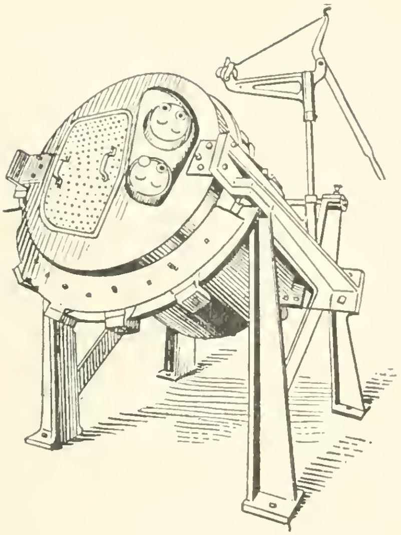

FIG. 5. TILTING TUMBLING MILL

This equipment is adapted to jobbing steel foundries with a wide range of work and should be used in conjunction with the hose machine, or with the sand-blast room; the latter equipment to handle the larger pieces and the sand-blast tumbling mill to handle the small and medium-sized castings. It is estimated that a 50x40-in. mill will clean about 1500 lb. of small castings, on the gates, within twenty to thirty minutes, using No. 3 sand and air at 80 lb. pressure. The amount it is possible to charge into the barrel varies considerably with the class of castings. Pieces weighing 1 to 3 or 4 lb. take up more room than castings 8 to 10 lb., and our judgment is that if a machine will hold 1500 lb. of the latter it will not hold to exceed 1000 lb. of the former.

TAKING CARE OF THE DUST

The dust from these mills is exhausted by

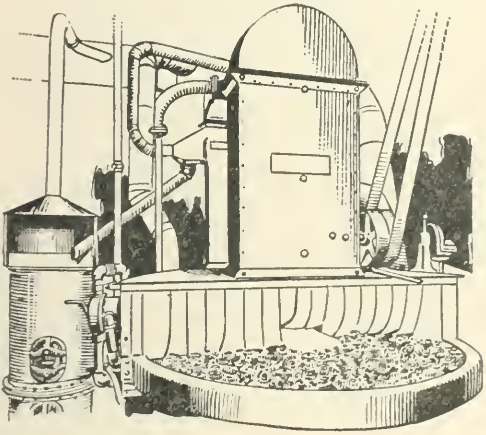

FIG. 4. ROTARY TABLE MACHINE

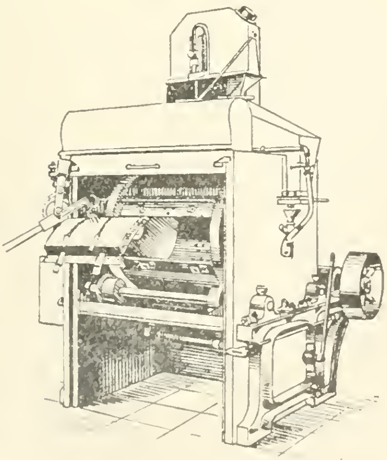

FIG. 6. HORIZONTAL BARREL

a fan of the proper size and the clean sand elevated to the bin above the mill, either by exhaust or by a bucket elevator system. The hoisting of the sand by air exhaust is preferable to an elevator whose working parts would be rapidly worn out by the action of the sand and would require frequent replacing.

THE SAND BLAST ROOM

The best method of cleaning large castings involves the use of the sand-blast room, Fig. 7. The room should be fitted with a grated floor having a hopper bottom beneath it to catch the sand and dust as they fall from the casting. The bottom of the hopper enters a pipe through which an exhaust system raises both the dust and the sand to the dust separator located at the top of the room and above the sand bin. The dust arrester consists of wood frames covered with a special grade of cotton duck. The dust passes through the screens leaving the clean sand to be returned to the sand bin and the clean air to the sand-blast room. The sand may be used directly from the bin by a hose or it may be returned to a hose sand-blast machine located within the room. The latter method is very satisfactory for jobbing steel foundry work as it enables the operator to stop or start at will, to control the hose with one hand and manipulate the castings with the other.

The sand-blast room may be built of brick, in which case it should have a wood paneling as the action of the sand on the brick wears the walls down very rapidly, or it may be of steel. In any case it should be tight enough to exclude the entrance of outside air which interferes with the work of the exhaust. No hard and fast rule may be laid down for the size and design of the sand-blast room. The requirements of the plant must govern each case.

VENTILATION IS IMPORTANT

Reference has been made to ventilation, which is a point to be clearly emphasized by means of exhausters of suitable design and centrifugal or screen type dust arresters. The former type of arresters is adapted to plants where it is desired to prevent diffusion of dust in the room where the equipment is located, and where it would not be objectionable to discharge a small amount into the atmosphere. With the latter type the dust is entirely suppressed and purified air returned to the room from which it was drawn instead of discharging into the atmosphere. This is a decided advantage and economy in the winter, as the necessity of continually warming incoming cold air is avoided.

THE QUESTION OF SAND

The grades of sand best suited for the different types of machines and character of work to be cleaned is a vital question. Here again the size of the foundry is a determining factor, and one which runs generally on small and medium-size castings and uses the smallest and simplest type of machine can use ordinary silica sand that has been washed perfectly free from dust and is perfectly dry. This is No. 1 grade. This is not the best sand to use, as being already a fine grain it is soon reduced to dust, but it is usually the easiest to obtain and costs so much less than the higher grades it is expedient for the small foundry to use it. The amount of dust which the fine sand creates would be a serious matter in a large plant, while it would not be very objectionable in a small one where the sand blast is only run two or three hours a day.

For the sand-blast room and the sand-blast tumbling mill, a grade of sand illustrated at the head of the article and designated A is recommended. This grade is about as large as can be handled satisfactorily by an exhaust system. It is sharp to begin with and does not require to be used and split up into small particles in order to get the maximum cutting effect. We have heard the contention made that the sharpness of the sand has nothing to do with the cleaning effect, that it is the force with which it hits the casting that does the work. This sounds about as reasonable as saying a dull razor will cut as well as a sharp one. The most desirable sand is that which does the work the best and in the shortest time, and which creates the smallest amount of dust.

The sand illustrations at the head of this article are from photographs made by the writer. The sand is abrasive material from Ohio, and it is shown both as new material, and after being used for a day; the difference in the appearance of the grains will show how they are reduced in diameter with use. Ocean sand, really smooth pebbles that have been worn down by the action of the waves, is better after it has been used for a short time, because it is split into smaller particles after it goes through the machine the first time and

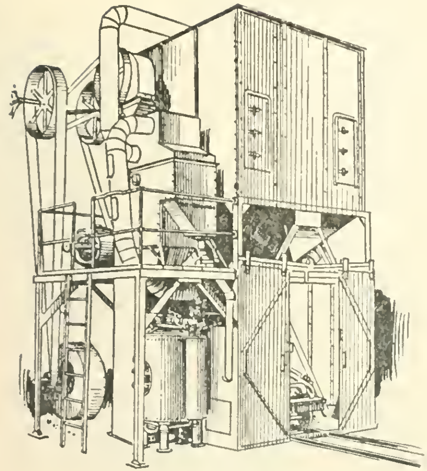

FIG. 7. SAND BLAST ROOM

the sharp edges increase the cutting speed. For foundries located at interior points, a long way from seaboard, the freight alone on ocean sand makes it rather expensive.

The adoption of the sand-blast has undoubtedly increased the cleaning room cost of the steel founder, but it has greatly improved his work, and the increased cost is more than compensated for in the saving in tool maintenance where castings are to be machined. Nothing is more injurious to machine cutting tools than the burnt sand on steel castings, and in these days of high prices for tool steels almost any expense necessary to remove the burnt sand is warranted.

THEY MEAN BUSINESS

All of the officials of Coleman-Shoemaker-Mead, Inc., Philadelphia, dealer in new and rebuilt machinery, and five other important men have voluntarily entered the service of the United States and the company will suspend its business after its present stock of machinery has been disposed of. The men who have gone into the service are as follows: R. F. Coleman, president, first lieutenant, Ordnance Department; F. F. Shoemaker, vice-president, United States Naval Reserves; C. S. Groove, 3rd, captain, U. S. Marines; Leonard Tissot, quartermaster, U. S. Naval Reserve; Rudolph Leibec, U. S. Naval Reserves; R. M. Harper, machinery inspector, U. S. Naval Shipping Board; Paul Tiers, Medical Corps, Naval Reserves.

HIGH FLYING*

At the beginning of the war the average height flown on active service was 4,000-5,000 feet, simply because few of the machines then in use, with the impedimenta carried, could get much higher. Today a height of 20,000 feet is, I believe, on certain occasions reached, and it is fairly certain that if progress continues at its present rate, heights a great deal beyond this figure will be reached as a usual thing.

THE COLD

These great altitudes bring forward many difficulties which will have to be seriously considered. The first trouble in the winter will be the extreme cold to which the occupants will be subjected unless they are protected by special cowling which will gather in the warmth given off from the engine. This, to a certain extent, is the natural advantage obtained in the tractor.

The question of the difference in the comfort of machines in this respect was shown to me in a very marked manner last winter. I was testing the fall-off of engine power at a height on a tractor two-seater in which it was specially arranged that the warm air from the radiator and engine passed along the fuselage to the pilot, and then to the passenger, and although at a height of over 21,000 feet with the thermometer below freezing at ground level, I did not suffer in the least from the cold, neither did my passenger, who sat behind, complain, until we shut off to descend.

As a contrast to this, a few days later, I was on a single-seater scout at an altitude of 17,000 feet, and although it was a tractor with a rotary motor, I suffered intensely from the cold, and became so numbed that my vitality must have been something akin to a dormouse under the snow, and, in spite of being well gloved, I had frost-bitten finger tips, which pained for many days afterwards.

Surely this is a very inefficient state for a pilot at the front to have to take on an air fight or other exacting work? Put two pilots up to a great altitude, one kept well warmed and comfortable, the other half dead with the cold, and it would be easy to surmise which would be most likely to do the best work.

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*By Captain B. C. Hucks, Royal Flying Corps, in a lecture before the Aeronautical Society, London.

I really believe it is more by accident than design that the pilot or passenger have benefitted at all in the past from the heat of the engine, with the exception, perhaps, of the late S. F. Cody's machine. He purposely placed the radiator of his pusher in front of the pilot to keep him warm. I know from my experience when flying in France in the cold weather that the discomfort owing to the extreme cold became intense when flying only at 6,000 feet on a two or three hours' reconnaissance flight.

This is a point which designers should give attention, especially as machines are now easily capable of reaching great heights. During summer weather, conditions would probably be tolerably comfortable, but in winter it would be well nigh impossible unless better arrangements are generally made.

During a recent heat-wave even, I have experienced cold of 20 degrees below freezing point at 20,000 feet.

Cold also affects the motor pretty seriously. This is more noticeable with the water-cooled type. Unless some provision is made for blanketing the radiator surface at heights, it becomes far too cold for efficient running. Cases are known of the freezing of the water system on a descent from a great height, with pretty serious results to the motor, as well as the difficulty of getting the engine to run again efficiently through being too cold to effect a landing. In the future war machine the pilot must have a very wide range of control over the water-cooling system.

RESPIRATION AND HEART ACTION

I will now touch lightly on effects that I have experienced on high flights. I have found the effect of high, *i.e.*, rarified, air to be felt slightly at about 10,000 feet, increasing with the altitude. Breathing becomes affected, respiration shorter and quicker, there is a curious oppressive sensation and a bulging feeling in the head until the height of about 20,000 feet is reached.

I am told by a medical friend who has made rather a study of the subject that there is always a risk of a sudden collapse, and oxygen should be used whether the aviator feels fit or not. Of course, the effect felt varies considerably with individuals, and with the state of one's health.

About eighteen months ago I suffered slightly with my heart, and found I could not get very high without feeling giddy, and after returning from a flight to 12,000 feet, I had palpitation, which lasted until the following day. In consequence, I had to abandon high flying until treatment got me fit again. This year I have made a number of high flights, and have felt no ill effects whatsoever; in fact, I find the more one gets accustomed to going up high the less the effects are felt. I am told that this also is the case in mountaineering.

I can remember the unpleasantness of my first flight to 15,000 feet. It was very marked, especially the pain experienced in the drum of the ears on descending. The fact that a flight now to 21,000 or 22,000 ft. does not have so much effect, I put down entirely to acclimatization.

USE OF OXYGEN

I use oxygen as a precaution when ascending beyond 20,000 ft., for the previously mentioned reason. A small bottle is carried, fitted with a special reducing valve, which is fixed in the fuselage within easy reach of the hand. No special regulation is required, as it is set to pass only the necessary amount of gas into the face mask which acts as a mixing chamber, with its inlet and outlet air valve.

The apparatus weighs 16 pounds, and contains sufficient oxygen for one hour's continuous use. After reaching 20,000 feet, I find it is only necessary to use the oxygen intermittently, and, accordingly, I simply hold the mask, after turning on the gas, over the mouth and nose, and take a few breaths of it, perhaps every half minute.

The effect to me is remarkable; most of the oppressive feeling vanishes, and, excepting for the unpleasant bulging feeling of the head, which you experience with a bad cold, the sensation is one of suddenly being again at ground level. The only after-effects upon landing from these high altitudes are that you seem to acquire a pretty good thirst, not a very serious hardship to many, due, I suppose, to the use of oxygen.

CAISSON DISEASE

If the speed of climb continues to improve at the rate it has for the past three years, it looks as though aviators will become subject to what is known as "Caisson Disease," due, I am told, to the sudden reduction in atmospheric pressure, such as divers are subjected to when they come to the surface from a great depth, owing to the nitrogen which has been absorbed by the system, in proportion to the atmospheric density, forcing itself too rapidly at any lower pressure from the system.

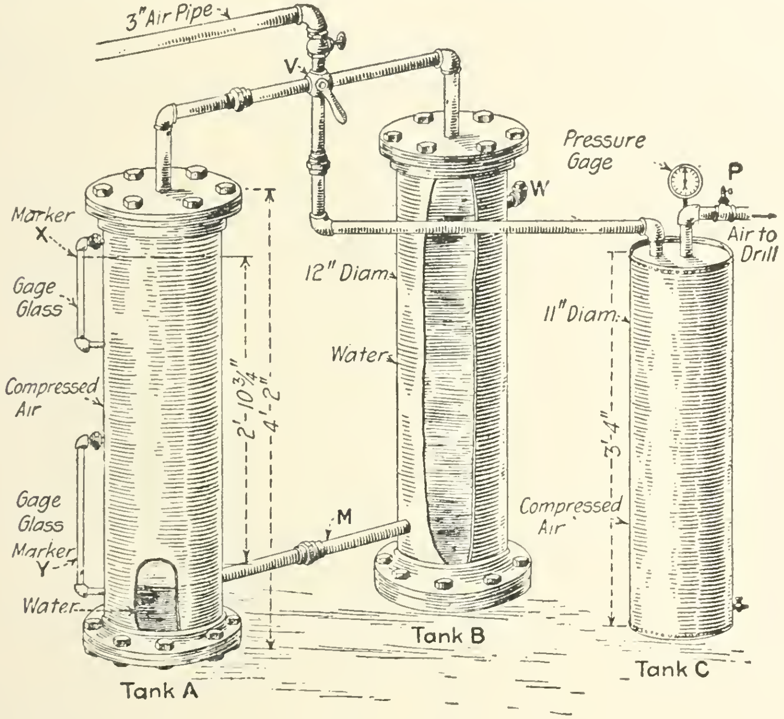

FIG. I

TESTING AND MAINTAINING THE EFFICIENCY OF DRILLS

BY H. H. HODGKINSON*

There is probably no company in the country that takes more pains to obtain the most efficient and up-to-date drilling equipment than the New Jersey Zinc Co., at Franklin, N. J. It was among the first to realize that efficiency in mining depends largely on supplying the men with efficient drills—machines which will drill rapidly; whose air consumption is low; whose maintenance is a minimum; and machines which, when put to work, will stay on the job. In the testing and development of drills, the company has gone to considerable expense, and judging from the results obtained, it has unquestionably paid to do so. When a new type of drill is received, every effort is made to get the best results in regard to drilling speed and air consumption that can possibly be obtained from that drill, and in addition the maker is given every assistance possible in his effort to develop a drill to meet the condition at hand. A drill-testing plant has been established in the mine for the purpose of obtaining accurate results in testing drills. This is situated in an abandoned pump station in the limestone hanging-wall. This white, coarsely crystalline limestone makes excellent ground in which to test the drilling speed of machines, having the advantage of being more homogeneous than the ore, while at the same time it has about the same drilling speed. The roof and sides of the old pump station afford an ideal place to test drills, making set-ups most convenient. Compressed air is delivered to the station by means of a 3-in. pipe at an average pressure of 95

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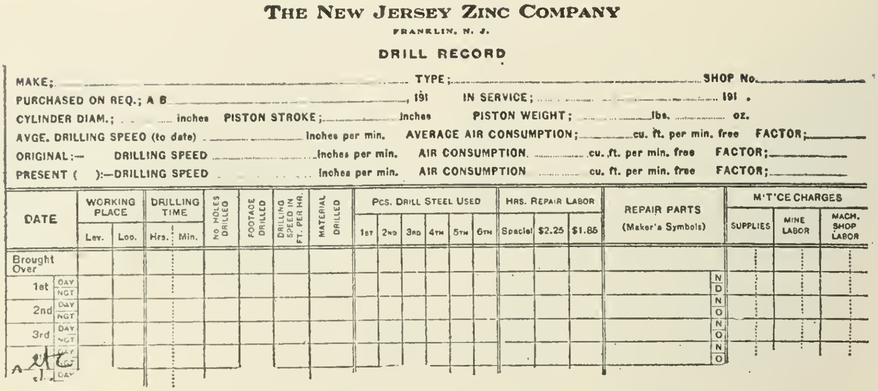
*Mine Superintendent, Wharton Steel Co., Wharton, N. J.



THE NEW JERSEY ZINC COMPANY
FRANKLIN, N. J.

DRILL RECORD

MAKE; ______ TYPE; ______ SHOP No. ______
PURCHASED ON REQ.; A B ______, 191 IN SERVICE; ______ 191 .
CYLINDER DIAM.; ______ inches PISTON STROKE; ______ inches PISTON WEIGHT; ______ lbs. ______ oz.
AVGE. DRILLING SPEED (to date) ______ inches per min. AVERAGE AIR CONSUMPTION; ______ cu. ft. per min. free FACTOR; ______
ORIGINAL:— DRILLING SPEED ______ inches per min. AIR CONSUMPTION. ______ cu. ft. per min. free FACTOR; ______
PRESENT ( ):—DRILLING SPEED ______ inches per min. AIR CONSUMPTION ______ cu. ft. per min. free FACTOR; ______

DATE		WORKING PLACE		DRILLING TIME		NO HOLES DRILLED	FOOTAGE DRILLED	DRILLING SPEED IN FT. PER HR.	MATERIAL DRILLED	PCS. DRILL STEEL USED						HRS. REPAIR LABOR			REPAIR PARTS (Maker's Symbols)		M'T'CE CHARGES		
		Lev.	Loo.	Hrs.	Min.					1st	2nd	3rd	4th	5th	6th	Special	$2.25	$1.85			SUPPLIES	MINE LABOR	MACH. SHOP LABOR
Brought Over																							
1st	DAY																			N			
	NGT																			D			
2nd	DAY																			N			
	NGT																			O			
3rd	DAY																			N			
	NGT																			O			
																				N			
																				O			
	DAY																						

FIG. 2

lb. per square inch. The apparatus used for testing the air consumption of a drill is shown in Fig. 1. It consists of two tanks *A* and *B*, both of the same dimensions made by screwing blind flanges to the ends of 12-in. pipe and boring out and tapping the pipes and flanges to make the necessary connections as shown. Tank *A* is equipped with two gage-glasses upon each of which a marker is placed at an interval of 34¾ in. Tank *B* is filled with water by means of the ¾-in. pipe *W*, which is fitted with an elbow and plug to facilitate the refilling of the tank when required. A 1½-in. four-way valve is situated at *V*, by means of which compressed air is supplied to the small receiver *C*, alternately from tanks *A* and *B*. When tank *A* starts to supply air, tank *B* is full of water as shown and the meniscus in the gage-glass is at the lower marker *Y;* as the air passes out of *A*, the water in tank *B* flows through pipe *M* and rises in tank *A* until it reaches the upper marker *X;* in the meantime the volume of water which passed over into tank *A* has been displaced by an equal volume of compressed air. The valve *V* is then reversed quickly by means of the lever, and the water gradually returns to tank *B*, the air displacing the water in tank *A* until the meniscus in the lower gage-glass reaches the marker *Y* and so on. The water is colored so that the mensicus is clearly defined in the artificial light. To facilitate the passage of the water back and forth between *A* and *B*, pipe *M* is 2 in. diameter, while the remainder of the piping is 1½ in. The third tank *C* is a small wrought-iron receiver which acts as an equalizing reservoir and supplies air to the drill at a more constant pressure and in addition catches any water in the air, or water which might have possibly come over from tanks *A* or *B* in case the four-way valve has not been closed properly, thus preventing the water from reaching the drill. This tank makes it possible to read the pressure gage mounted at the top of the tank more accurately, as the indicator of the gage does not flutter with each movement of the valve of the drill, as would be the case if it were not in the system. At the bottom of tank *C* is a small pet-cock to drain any water so that the volume of the receiver is not cut down, in addition to keeping it away from the drill. At *P* another small pet-cock is inserted for the purpose of raising or lowering the water in the tanks to the markers in order to start a test.

By using these tanks in testing a drill, the volume of compressed air is kept constant for each run, while the time, inches drilled and air pressure are the variables; that is, five tanks of compressed air are supplied for a run which is equivalent in this case to 11.38 cu.ft. The time required by the drill to consume this amount of air, the inches drilled and also the pressure in pounds per square inch are recorded. A 1¾-in. raised-center cross-bit is the standard used for testing purposes, and the condition of the bit at the end of each run is noted as being either fine, good, fair or poor. Good results cannot be obtained when the drill bits are poorly made. The air consumption and drilling tests are recorded as shown in Fig. 2. The factor obtained in the last column is of great value in comparing different types of drills. In addition to the care in testing drills when first received, the company has gone further by keeping a permanent daily record of each machine.—Eng. and Min. Journal.

A STEAM HAMMER CONVERTED TO AIR

The Cumberland County Power and Light Company of Portland, Me., has recently been successful in the conversion of steam-hammer equipment to electro-pneumatic service, a pioneer installation being made at the plant of the Marine Hardware and Equipment Company. At this plant a 1200-pound Bement-Niles steam hammer was in service, steam at about 90 pounds per square inch being required for many hours daily. To avoid condensation troubles, it was necessary to run the hammer practically continuously. As electric-motor drive had been adopted for other purposes throughout the plant, it was found possible to do away with the demand for continuous high-pressure steam by adapting the steam hammer to air operation and installing a motor-driven compressor to supply air for this purpose and other requirements. The valve of the steam hammer was rebuilt for a fit of 0.0025 inch compared with a previous fit of 0.005 inch under steam service. The Hardware company purchased a 50-horsepower, 220-volt, three-phase, Westinghouse squirrel-cage induction motor designed for 900 revolutions per minute, and belted it to a 12-inch and 7-inch by 12-inch compressor delivering air at 90 pounds to the storage tank supplying the compressor. A branch exhaust terminating at two ½-inch pipes was led down the frame of the hammer to outlets directed upon the working anvil surface, so that all chips and scale are immediately blown away in operation. It was found that harder and quicker blows could be struck than under steam conditions.—*Journal Franklin Institute.*

A PISTON AREA CHART

The following article by N. G. Near, reproduced from Marine Engineering, October, 1917, should be doubly valuable in steam driven air compressor computations since it is equally applicable to both ends of the machine.

To subtract the area of the piston rod has always been a sort of "pest" for engineers in general when making computations for horsepower directly from indicator diagrams. The head end of the cylinder has always been easy enough to work out, but the crank end invariably contains that infernal piston rod.

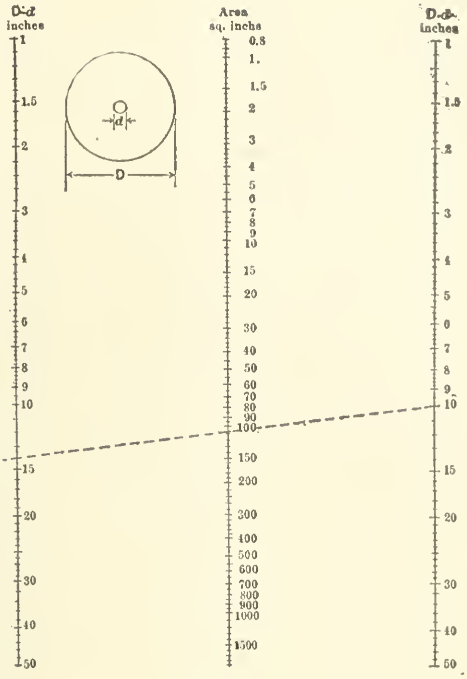


FIG. 1

The other day I hit on a scheme for lightening the labors of making computation of this sort, and prepared Chart No. 1 for that purpose. I believe the idea is "brand new" and it works as follows:

Where D = diameter of cylinder in inches,
and d = diameter of piston rod in inches,

just add D and d and find the corresponding figure in the left-hand column of the chart. Then subtract d from D and find the corresponding figure in the right-hand column. Connect the two figures with a straight line and the middle column gives the area with the piston rod area already subtracted.

If the chart isn't accurate enough for you it will at least tell you whether or not your long-hand figures are "anywhere near accurate."

For example, I have chosen a 12-inch cylinder and a 2-inch rod. My figures, therefore, are 14 and 10, and the middle column shows the area to be very close to 108 square inches. Computed the long-hand way, I find the area to be actually 108.2 square inches. So the chart is fairly close.

The chart can also be used just as readily for finding the area of the head end of the

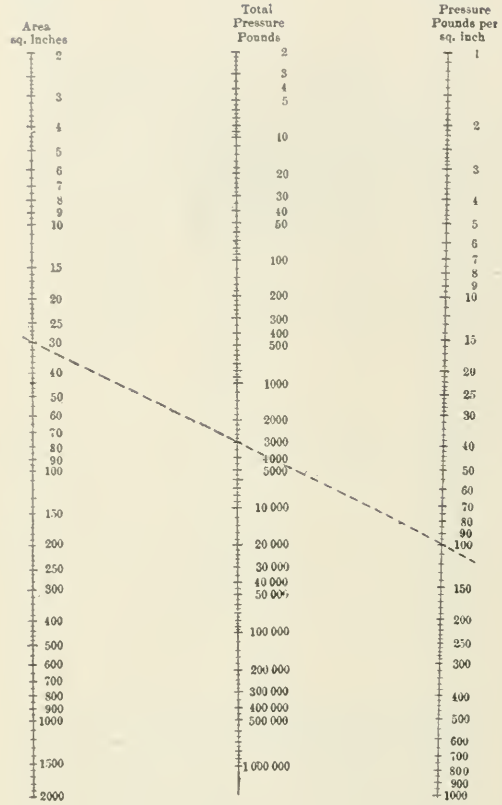


FIG. 2

piston. In that case $d = 0$, and we have to use D in each column.

For example: Find the area of a 10-nich circle. Just connect 10 in the left-hand column with 10 in the right-hand column, and the intersection will come close to 78. Mentally, perhaps, you can figure that the exact area of a 10-inch circle is 78.54 square inches. It happens to be exactly equal to 25 Pi.

"Area × Pressure" Chart

After finding the area of the piston we always have to multiply by the "mean effective pressure." To lighten that task, or at least to make you sure of your figures and decimal points, Chart No. 2 was designed.

The chart is very simple and needs no further explanation. The dotted line drawn across shows that 30x100 = 3000. The range of the chart is wide enough for any steam pump or air compressing problem inside of 1,000 lb. per sq. in.

POWER-LOSSES IN PNEUMATIC TIRES

The result of a series of experiments on the power-losses in pneumatic tires were discussed at a meeting of the Pennsylvania Section of the Society of Automobile Engineers, by E. H. Lockwood. It was found that while the rolling resistance varied considerably for different kinds of tires, it was practically constant for a given tire for all speeds up to 40 miles per hour, the highest speed which the conditions of the experiments allowed. The distribution of internal power-losses was found to be as follows: A six-cylinder Chalmers chassis was used, the tires were 32 by 4 in., the load on the front wheels was 1145 lb., the load on the rear wheels was 1545 lbs., and the tire-inflation was 75 lb. per square inch. Rolling resistance:

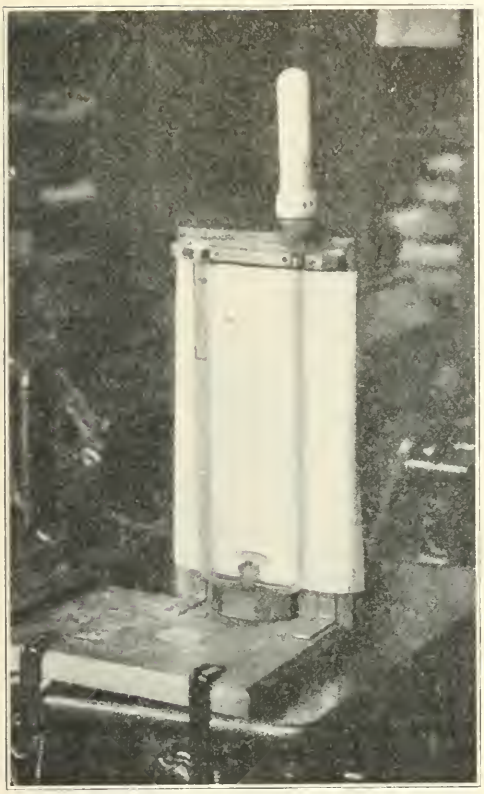
	lb.	Per cent.
Front tires	18.2	31.2
Rear tires	17.7	30.3
Front bearings	4.7	8.0
Rear bearings and transmission	17.9	30.6
Total	58.5	100.0

TWO NEW AIR MEASURING INSTRUMENTS

The instruments here spoken of were mentioned by Mr. George T. Palmer in an address before the New York Chapter of the Heating Engineers and attracted much attention. The account here presented is obstracted from The Heating and Ventilating Magazine, September, 1917.

THE ATMOMETER

The first of these instruments, shown in the halftone above, is for the purpose of measuring the drying or moisture absorbing power of the atmosphere under varying conditions of pressure, temperatures, etc. It consists of a slim cup of porous material, seen projecting at the top of the instrument, which is attached to one arm of a glass U-tube with the free arm graduated in tenths of a cubic centimeter. The apparatus is prepared for use by filling the cup with distilled water, to which a trace of copper sulphate has been added to prevent the growth of molds or small plant life. The capillary arm of the U-tube is then inserted in the cup, the arm being filled with



THE ATMOMETER

water up to the stop cock. These parts are held together by the rubber stopper which makes a water-tight joint.

The instrument is now inverted with the porous cup uppermost, as seen in the halftone, the graduated arm of the U-tube is filled with water and, on making sure that no air bubbles have been entrapped, the instrument is ready for use although sufficient time should be allowed for the water to make its way through the porous cup before observations are taken.

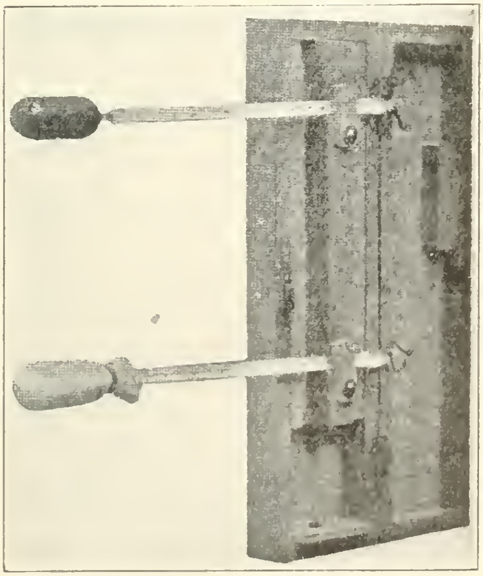
As water evaporates from the surface of the porous cup, more water flows up through the capillary arm to take its place. The amount of water evaporated in a certain time is read off directly from the water level in the graduated arm.

The instrument is useful in measuring the relative drying effects of air at various temperatures, humidities and rates of air movement. It has been used by horticulturists in studying the effects of dryness and moisture on plant growth, and its use is described in a paper entitled "Atmometry and the Porous Cup Atmometer," by B. E. Livingston. This paper and the Cup may be secured from *The Plant World*, Tucson, Arizona.

THE KATA-THERMOMETER

This instrument measures the combined effect of the three modes by which air abstracts heat from a hot object: radiation, convection and evaporation. It consists, as seen in the photo, of two elongated glass bulbs filled with a colored spirit, one of the bulbs being cloth-covered and the other uncovered. The tubular stems of the bulbs are graduated in degrees Fahrenheit to read from 95 to 100. The bulbs are placed in hot water until the spirit column rises well above the 100 degree mark. The uncovered bulb is then dried and either placed in the rack provided or suspended by a string. The cloth covered bulb is gently shaken to remove any excess of water and then exposed the same as the dry bulb.

Both bulbs lose heat to the surrounding air, and their rate of losing heat is measured by timing the spirit column in its fall from 100 to 95 degrees. Each bulb has a coefficient which is divided by the time of fall in seconds, and the quotients obtained, when added together, express the heat extractive power of the air in terms of calories per square centimeter per second.



THE KATA THERMOMETER

The kata-thermometer is useful in measuring the deheating effect of the atmosphere during the time the reading is being made. It is not possible with this instrument, however, to follow the slight fluctuations in deheating effect which are constantly occuring. Prof. Phelps, of the New York State Commission on Ventilation, has attempted to meet this situation with a wet-bulb thermometer to which a constant amount of heat is supplied through an electrically-heated coil. If the heat production is constant then any change in the rate of heat loss must show itself in the actual temperature of the instrument. If the air temperature and relative humidity are high and the air movement is slight, the rate of heat loss from the heated bulb will be slow and, inasmuch as the amount of heat supplied does not change, the mercury column on the thermometer will rise up to a point where its rate of heat supply and heat loss is balanced. Heat is thus being stored up in the instrument.

In a cold atmosphere heat is taken away from the bulb about as quickly as received and the mercury column does not get an opportunity to rise. The fluctuations in rate of heat loss may then be determined by reading the mercury column at intervals or by fitting up a bulb on a recording psychrometer and thus obtaining a continuous inked record of the heat loss changes.

This type of instrument has been named the "Comfortmeter" as it measures, in a way, the degree of comfort which air produces. It is the rate of heat loss from all causes that determines body comfort and this instrument as does the kata-thermometer, measures not merely the temperature of the air alone, not merely its relative humidity, not merely the velocity and constancy of air movement, but the combined effect of all three.

Two forms of the "Comforter" have been used by the Ventilation Commission in its work. This instrument, however, is in an early stage of development and any further details of construction are without special interest at this time. The significance of the readings and the form of scales used must also await further experience for interpretation. The kata-thermometer was designed by Dr. Leonard Hill, of London. It is manufactured and sold in this country by the Fiebe-Gorman Co., Monadnock Block, Chicago, Ill.

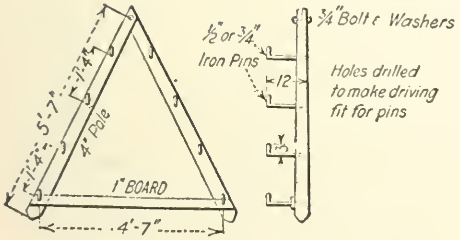
UNDERGROUND DRILL RACK

The use of hollow steel in rock drilling has brought its special disadvantages, one of which is the tendency of the water hole to become plugged with sludge and grit. When this happens it causes a delay to the miner, who usually tries to clear the hole and use the drill if possible. When he is not successful, which is usually the case, it means that the drill can not be used until it has been returned to the blacksmith shop, cleared and sent down again. When a large number of drills are to be sharpened, the fact that a drill is plugged but not dulled will escape the notice of the man at the forge; and the result is an entirely superfluous re-sharpening and retempering of the steel. Such complications add to the expense of operating rock-drills when this kind of steel is used.

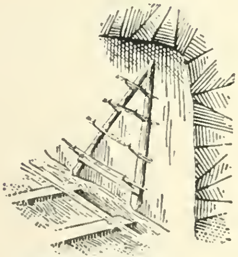
There are various ways by which hollow steel is caused to become plugged. The chief one is the manner in which it is handled underground. A trip through the mine will show a surprisingly large number of drills lying around in the dirt. This affords an excellent opportunity for material to lodge in the hole, causing it to choke. Miners, for convenience, will stand their drills in a row along the wall, thereby facilitating the entrance of dirt in the end standing on the ground. It would seem impossible to prevent this evil unless suitable racks are provided. Many types of racks are in use but most of them are permanently fixed in one place. This is a disadvantage in drifting operations in which the miner gets farther away from his drill rack as the drift advances. If a new rack is not built in a more accessible spot, he will keep his drills nearer his machine any way, and they will soon be lying around or standing up in the dirt again.

To overcome the difficulty, the rack shown in the illustration was designed. It consists of two poles fastened together at the top with a bolt and properly distanced at the base by a board. The iron pins on which the drills are supported are driven into holes previously bored in the poles and can be made of scrap material. The distance board at the base has a large hole bored at each end, which permits the board to slip down over the bottom pins of each pole.

The whole rack can be easily and cheaply



FRONT VIEW SIDE VIEW



PERSPECTIVE SKETCH

UNDERGROUND DRILL RACK

built and may be taken apart by removing the bolt and slipping off the baseboard. This makes it a one-man job to move from one place to another.

A glance at the sketch will show that drills of different lengths may be kept separate, and the bits and shanks can be inspected without picking up each drill. This saves time for the miner and facilitates the work of the nipper or any other man responsible for the distribution and care of drills.—*Eng. and Min. Journal.*

SPEEDING UP THE DRILL

Considerable discussion and effort has taken place in an attempt to get more work from machine drills. There are many ways in which this may be accomplished but also many obstacles when it comes to active practice. It is the object of this article briefly to outline some of these methods and to describe one in particular.

In analyzing the cost of breaking rock it has been found that the greatest item of expense is miners' labor, and the labor situation of today is such that it is poor policy to try and get any more work out of a man. The only way out of the difficulty is to make it possible for a man to do more work without expending any more energy. In view of such considerations methods of speeding up the drill seem to offer the best solution and group themselves under the following heads: (1) Increasing the actual drilling time of the machine. (2) Increasing the reciprocating speed of the machine.

The importance of the first factor is realized by few. A little time spent with the stop watch will show that machines are actually operated from 25% to 50% of the total shifts' time, or from two to four hours of the customary eight. Personally, I have never known one to run as high as four hours out of eight. The rest of the time is spent in various other operations, such as "mucking back," mounting, changing drills, moving the machine, tearing down, loading and firing the holes, etc. All these things have to be done by the miner and take up a large part of his shift.

The diminution of such delays must be made according to the conditions in various places. In a general way only a careful study of delays will suggest remedies. In many cases lighter machines and mountings can be used to advantage. In drifting the miner's greatest delay is mucking out a place for his post. Where there are two 6- to 8-ft. wide drifts not too far distant on the same level, the following is a good time-saving method:

Instead of using one machine per shift in each drift, work both machines in one drift on the day shift and move them to the other on the night shift. In the mean time the first drift is mucked out and ready for a clean start on the following day shift. This adds from one to two hours to the available drilling time. Needless to say, the miners are glad to be relieved of the strenuous mucking at the start of the shift. There is no additional labor involved in this arrangement and it is only impracticable where the ground is so soft that there is not enough drilling in a round of holes to keep two machines busy for a shift. Careful attention to the supply and quality of drill steel will also help to increase the machine's running time. These are merely suggestions and may not apply in all cases. Some day the rock-drill manufacturers will devote more time and study to the designing of a machine that will facilitate the changing of drills and other operations that mean lost motion to the miner.

In the second method of speeding up the

drill it is evident that, if a machine is only reciprocating from two to four hours in a shift, everything should be done to get a maximum amount of hole drilled in that time. This means a close study of different types and makes of both machines and drills to determine what is best suited to the ground. There are several makes of machines on the market as well as a diversity of opinion as to which are best. That is a question that can only be decided by experiment in each case. The same applies to various types of drill bits. Of course, a small hole can be drilled faster than a large one and here we have the big advantage of the Carr bit with its small gage changes. On the other hand, a small hole will not hold so much powder. In the latter case the solution is either to use stronger powder or place a smaller burden on each hole. The powder solution is preferable, of course, but there are mines where the ventilation is too poor to care for the larger volume of fumes that come from powder of greater strength.

There is one thing that will increase drilling speed in all cases and that is getting every available pound of air pressure behind the hammer. Pressure-drop through pipes, hose, inlet ports, etc., has been carefully measured and recorded, but there are still a surprisingly large number of mines where no attention is given to such matters. To put the loss in drilling speed into something more tangible than merely the pounds drop in pressure, an interesting test was conducted.

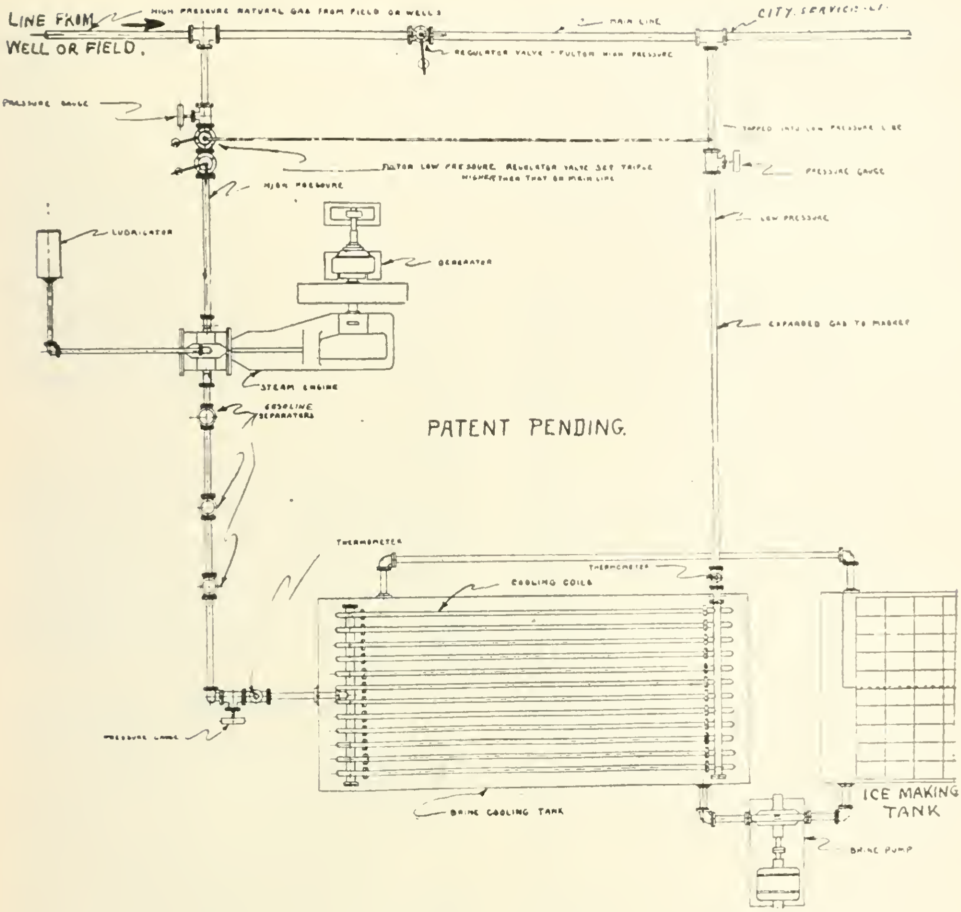
A place was selected where there were two machines in good condition, supplied with air through oversize pipes to insure a maximum pressure. A globe valve was inserted in the pipe line near the machines, and a pressure gage attached between the valve and the machines. For an entire shift the pressure was kept down to 55 lb. by manipulating the valve, and the drilling speed of the machines recorded in the usual manner. The next day the test was repeated with a constant pressure of 70 lbs. This 15-pound increase in air pressure increased the drilling speed by 37 per cent. By drilling speed is meant inches drilled per minute of actual reciprocating time. The result obtained was almost startling although the test was simple and easily performed. A 15-lb. drop in pressure is quite common in conducting compressed air through pipes, but a difference of 37% in drilling speed is enough to make anyone "sit up and take notice." In this particular case it led to a careful investigation and to the adoption of certain standards in regard to minimum size pipes, hose, inlet ports and connections. The air-pipe equipment of each level was carefully worked out so as to comply with a fixed maximum permissible drop in pressure.—*Eng. and Min. Journal.*

SMOKE

Before means can be found to reduce smoke, it is obvious that the causes of its production must be understood. The erroneous opinion prevails that black smoke contains a large amount of combustible matter, and that it is a sign of greatly reduced economy. The most dense black smoke does not commonly contain more than ½ of 1 per cent. of the combustible fired. The extreme fineness and the distribution of the carbon particles bestow upon them a high coloring power. The losses are negligible in comparison with those due to incomplete combustion or excessive air, which generally accompany combustion without visible smoke. The carbon particles producing visible smoke are not derived from a lifting of fixed or solid carbon from the grates, but they are formed from gases during the combustion process.—*Power.*

OFFICIAL LIST OF MINE-RESCUE EXPERTS

The Bureau of Mines, Department of the Interior, in a report just issued prints as a roll of honor the names and addresses of the miners throughout the country who have taken the bureau's course in mine-rescue work from July 1, 1914, to June 30, 1916. Copies of this report are being sent to every mine operator and state mine inspector in the country, in order that in the event of a disaster in his district or at his mine, he will be able at once to determine the nearest available trained men for rescue work. Mine owners in the past have cooperated in this manner as much as they could, but have sometimes been badly handicapped and delayed in endeavoring to learn which miners have been trained in rescue work. The report gives the names and addresses of more than 3,000 men.



POWER AND REFRIGERATION FROM HIGH PRESSURE GAS

MECHANICAL POWER AND REFRIGERATION FROM HIGH PRESSURE GAS

Natural gas which is now transmitted in great volume and for long distances is also during transmission under heavy pressures, say from 50 lb., gage, up to 300 lb. or over. For profitable transmission the high pressures are imperative, as permitting the use of pipes of comparatively small diameter, and this pressure may be the natural high of the gas at the wells or it may be due to the employment of boosting compressors at certain points on the line. In either case before the gas is distributed for service the pressure is nearly all released so that only 6 or 8 ounces remain.

In this reexpansion of the gas before use there is a great opportunity for power development and also for useful refrigerating effect which thus far has not been realized except in a few exceptional cases. This matter is discussed in a paper by Auguste Jean Paris, Jr., printed in Natural Gas and Gasoline.

This is, he says, an efficiency problem pure and simple. Efficiency at the reducing station, which also may be made to increase the efficiency of the compressor station while supplying at the same time several products of value, such as power, gasoline and ice.

The reducing station, which I suggest, is one to take the place of present design, and consists of engines, similar to steam engines, wherein gas under pressure would be used instead of steam.

Every engineer knows that gas, under pressure, will drive a "steam" engine just as well as steam; it being but a matter of expansion. The greater the expansion the greater the efficiency.

In this plan the expansion engine acts as a reducer, and reduces the pressure on the main gas transportation pipe line to a predetermined low pressure to be maintained on the city service line. There may be one or more of these engines. In fact, it would not be good practice to depend wholly upon one unit.

The several units should be of a size equal to one-half of the minimum quantity of gas required per minute at any time of the day or night, excepting in cases where such quantity is too small to produce power, in which event the regulators on main line would automatically handle the situation.

The quantity of gas permitted to pass from the high pressure mains to the low pressure city service lines is absolutely controlled by using the regulation type of reducing valve, such as the "Fulton," in the pipe-line leading the gas to the steam engine, with a small controlling pipe attached to the exhaust of the engine; the engine exhaust being the low or city service line. In this manner the "Fulton" regulator would, it may be seen, perform the same duty as in all present designed reducing stations, excepting that the gas in the method I point out, would pass through the expansion cylinder, *prior to its entrance to the city service lines.*

The high pressure gas in this system is made to do work on the piston, or other moving part of a reciprocating or turban expansion cylinder of the engine, thereby producing power as pointed out, through the reduction of the pressure from the high pressure of the main gas transportation pipe line to the low pressure of the city service pipe line.

The utilization of this lost power represents a conservation of natural and artificial resources, which up to this writing have been wasted, and for instance this power can be used for a variety of purposes, generating electricity, which, in turn, may be delivered back to the compression station and there used to drive part of the compressors supplying possibly 40% of the power required in such station.

This plan obviously increases the efficiency feature of the gas compression station by at least this same 40 per cent.

Of course this engine-produced power could in certain instances be used near its point of production, for various purposes, such as local lighting, and power in the city, where the reducing station is located. This being a matter to be determined by local conditions, I consider that about 40 per cent. of the energy or power stored in high pressure gas pipe transportation lines is now wasted, yet may be conserved and utilized. Most of this energy and power is a natural resource, as commercial natural gas is usually delivered by nature under high rock pressure, pressure used to carry the gas through the main transportation pipe lines, a pressure that if supplied by artificial means, would require millions of horse-power.

In many instances artificial means are used, for supplying the high pressure, especially where the natural pressure has beeen reduced by constant drainage of the gas from the wells and it can be figured that here there may be a saving accomplished of from 50 to 100 horsepower for each 1,000,000 cubic feet of gas delivered into low pressure lines, from high pressure lines.

I am informed that West Virginia alone has over 2,000,000,000 cubic feet of high pressure gas being sold daily, and many times that quantity bottled up in wells, which is being conserved. This power could be doubled by simply preheating the gas prior to expansion.

It is a well-known fact that when natural gas is used expansively, like steam, in a steam engine, it not only reduces the pressure from high to low, in the power generating process, but also that the temperature of the gas, is lowered, whereby refrigeration may be produced.

It is possible to produce a temperature of 100 degrees below zero F. or lower. Therefore, under these conditions, the pressure reducing engine may become a refrigerating machine. The exhaust or low side, of the expansion cylinder, delivers gas into the city service not only at any predetermined pressure, but at a very low temperature.

Located in the exhaust line, leading to the city service line, I suggest placing separating devices, the function of which would be the separation of any condensible vapors, such as gasoline, etc., under temperatures, such as those produced, in this operation, thus all gasoline, etc., will drop out of the gas:—absolutely all of it; for there can be no other means as efficient, in this respect, thus supplying, as supplemental to the main object of this process, a gasoline plant to recover such of this material of great commercial value as may remain in the gas after earlier extraction at extraction plant, or where recovery may not have been earlier attempted.

The gas, leaving the gasoline station, having lost none of its refrigerating effectiveness, can be used for ice making, by passing the cold gas through brine (just as in an ice plant), the brine in turn refrigerating the water, and producing ice; the gas then being delivered through the city service lines to the consumer for heating and lighting.

My point has been to produce power, gasoline and ice, by machinery consuming no fuel increasing thus both the efficiency at the compressor station, and at the reducing station—efficiency, as it were, both coming and going; a dual conservation of natural resource.

Power, gasoline and ice are produced by this plan right at their market, in a city's suburbs, at no additional cost. It is simply utilizing the power inherent in the gas itself, saving waste-energy, and making it do work.

The entire station works like a by-pass, around a present style reducing station, which is not disturbed, but left ready to perform its work as of old, with the added efficiency, of new, and scientific methods.

THE LOW BID

The contracting business is sorely afflicted with a custom. This custom is a blight, a killing frost, a curse. In parliamentary language this troublesome agency is called the low bid. The low bid is one of our cherished institutions. It is lovely in theory. In practice it is as a monkey wrench hurled into the machinery of construction. Everything would be lovely if it were not for the fact that a fool is born every minute and that an amazing number of them born into the contracting business. Knowing nothing whatsoever about costs they keep bidding until they are decidedly low on some job. Owing to the prevailing willingness of city officials to sting the contractor on occasion, the ridiculously low bidder is awarded the job. Lacking experience and an organization he is soon head over heels in a dozen kinds of grief. He throws up the job or stays on and goes broke. This makes for poor construction, delays completion, increases costs and balls things up generally. Meanwhile the responsible bidders are looking for other jobs, occasionally winnning out, of course, at a fair price, but being often thwarted by the irresponsible low bidder. There is generally at least one such bidder at every letting.

Isn't it about time for engineers to come to the rescue of contractors in this connection? For humane reasons why not save the irresponsible bidder from his ignorance and folly? He is a good man, as often as not, but is out of his element. With credit at the bank and an inclination towards contracting, and a desire to win the supposedly large profits in the business, he takes a flier in the construction business and speedily goes broke. Let engineers warn their employers against the irresponsible bidder. Let engineers explain that it never pays to underpay a contractor. The owner invariably suffers when an attempt is made to gouge the contractor, especially a contractor who is incompetent, inexperienced and not any too strong financially.—*Municipal Engineering.*

THE AIRPLANE RECORD KEEPS MOVING

The recording of airplane records is the business of the daily rather than the monthly publication. The possibility of trans-Atlantic flight is rapidly coming nearer. On September 24 Captain Marcus Giutio Laureati, of the Italian air service, carrying one passenger, flew from Italy to England without a stop. He left Turin at 8.28, Italian time, and landed at Hounslow, a suburb of London, at 2.50 p. m., 656 miles in 7 hours 22 minutes, or an average rate of approximately 90 miles an hour. Captain Laureati flew an Aila machine, and carried two machine guns. From Turin he followed the railroad as far as Susa, on the Italian frontier. Crossing the Alps (Mont Cenis) at an altitude of nearly 12,000 feet, he passed over Lanslebourg and followed the railroad from Modane. He passed to the east of Paris, and crossed the English Channel in 15 minutes. He carried an autograph letter from his King to King George. During the flight he took food from a bottle fastened inside his coat and fitted with a rubber tube like an infant's feeding bottle. On August 26 Laureati flew from Turin to Naples and back, a distance of 920 miles, without a stop.

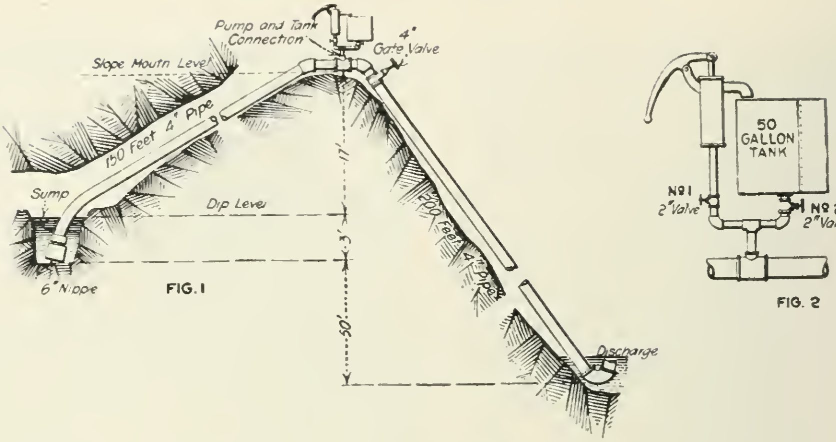


FIG. 1 FIG. 2

THE SIPHON IN THE MINE

SIPHONING MINE WATER

BY JACK L. BALL

Except by natural drainage, the simplest method of taking water from a slope mine, mechanically, is by siphoning. At times this may develop some uncertainty of action but with a little care in installing a siphoning apparatus, together with a slight knowledge of hydraulics, one ought to experience but little trouble.

The first thing necessary is pipe of a diameter sufficient to carry off the water as fast as it collects; the next is to have the siphon air-tight; then to see that the pipe is leveled properly; that is, that there are no depressions in the line which will cause air pockets to form, as this seriously interferes with the successful operation of the siphon. See that the discharge end of the siphon is well below the suction level, the more the better.

Theoretically, the height to which water can be raised, conditions being perfect, is 34 ft. At this distance there would be no flow, because the pressure on the discharge side would balance the pressure required to raise a column to this height, which is the atmospheric pressure taken at sea level—14.7 lb. To achieve good results one should not go over 25 feet.

Figs. 1 and 2 illustrate a siphon that was installed in a slope mine in western Pennsylvania, and to the writer's knowledge this was operated very successfully for several years. Referring to Fig. 1: From the slope mouth to the bottom of the dip the lineal distance was 150 ft., and from the sump bottom level to the slope mouth level the height was 20 ft. From the highest point of the siphon to the end of the discharge line the distance was 200 ft., and the vertical drop was 70 ft. Four-inch pipe was used throughout, except a 6-in. nipple 1 ft. long, which was put on the end of the suction to insure an unrestricted flow of water at that point. When necessary the pipe was bent, and ells were used only at the end of the discharge.

Fig. 2 shows a bucket, or common-well, pump and a 50-gal. iron tank connected to the siphon slightly beyond the highest point, with 2-in. pipe and fittings. To start the siphon, valve 1 was opened and the pump operated until water was pumped out, the surplus going into the tank, thus insuring a tank full of water at all times. The 4-in gate valve shown in Fig. 1 was then opened and the valve in the pump line closed.

The tank was connected in the same manner as the pump, kept full of water, or nearly so, and when at any time the flow of water from the siphon became intermittent valve 2 was opened, letting enough water into the line until the flow became steady again. At the end of the discharge line, Fig. 1, an ell was placed together with a 4-in. nipple 1 ft. long One of the characteristics of a siphon is that unless precautions are taken air will enter at the discharge end, work gradually back in the siphon to the suction end and break the flow. To prevent this the ell was placed in the position shown, with the nipple almost vertical. This acted as an air seal and eliminated almost entirely any air that might have entered at this point.—*Coal Age.*

BRAKE PIPE LEAKAGE AND COMPRESSOR CAPACITY

BY C. R. WEAVER*

The whole question of brake pipe leakage resolves itself into what quantity of air may be permitted to escape from the brake system and still permit charging, maintaining and replenishing the brake system in such time as will not impose limitations upon traffic in the way of delays, getting trains ready in the yard, and operating them over the road.

It is very difficult to ascertain what quantity of air is actually leaking out of the brake system. It is not difficult to find out what drop takes place in the pressure, but this varies owing to variations in methods of making tests, positions assumed by triple valves, etc. It is not difficult, however, to fix on some quantity of air that may be permitted to leak out of the brake pipe and then supply in the yard this quantity of air to a train previously charged and observe whether or not the quantity supplied does, or does not, maintain the required pressure. If it maintains or more than maintains the pressure, it is apparent that the leakage of the train is no more than can be permitted. If it does not maintain the pressure then the leakage must be reduced to the point where it can be maintained. The permissible amount of leakage from the entire brake system is the starting point. Too much leakage must not be allowed or an undesirably large compressor capacity or high degree of compressor maintenance will be necessary. An excessively low amount of leakage must not be insisted upon, or traffic will be interfered with on account of the time required to stop the leaks.

In order to arrive at some basis of what would be the allowable leakage, the Interstate Commerce Commission condemning tests of air compressors is the basis of the available compressor capacity. This, by the way, in the writer's opinion allows too wide a variation in the condemning tests. A New York No. 5 compressor is only required to deliver 59 cu. ft. of air, which is only 65.5 per cent. of its capacity when in good condition, whereas the 8½-in. cross-compound compressor is required to deliver 80 cu. ft. of free air, which is 90.5 per cent. of its good condition performance.

DETAILS OF TESTS

It was decided to determine the leakage by means of an orifice through which air would be supplied at a definite pressure which would be sufficient to provide for the maximum amount of allowable leakage. If, with this arrangement it was not possible to maintain the pressure in the brake pipe, then the leakage was too great. If the brake pipe pressure remained the same, or was raised, it would then be known that the leakage was not excessive. The tests were made on a 100-car freight train, conforming to the following specifications:

Size of equipment, 10-in. (combined); length of cars, 42 ft.; brake pipe volume per car, 920 cu. in.; auxiliary reservoir volume, 2,440 cu. in.; leakage uniformly distributed at car 4 and every tenth car up to and including car 94, regulated by cocks in branch pipe near triple valve; test gages on branch pipes of cars 1 and 95 and on auxiliary reservoir of car 1.

The locomotive equipment was as follows:

Brake equipment, No. 6 ET; main reservoir volume, 50,000 cu. in.; main reservoir pressure, duplex control 100 lb. and 130 lb.; compressor, two 9½-in. or one 8½-in. CC.; steam pressure, 195 lb. to 210 lb.; test gages on main reservoir and brake pipe.

The orifice was placed between the yard air system and the train with a by-pass in which was placed an air meter (Toolometer) by means of which the amount of air passing through the orifice was determined.

Two main classes of tests were made which may be referred to as charging tests and pump-up tests. The first charging tests were made with an orifice of 17/64 in. in diameter, which was computed to furnish an amount of air equivalent to 75 per cent. of a New York No. 5-A compressor capacity. With this orifice and a constant pressure of 80 lb., the brake pipe leakage was regulated until the air flowing through the orifice was just able to maintain 70 lb. pressure in the brake pipe of the first car. By means of the Toolometer it was found that this rate was 41 cu. ft. of free air per minute.

This rate was used as a basis for making the pump-up tests, using the locomotive with two 9½-in. compressors and 200 lb. steam pressure. Fig. 1 shows a graphic record of the results of the pump-up test in which an empty train was charged to a pressure of 70 lb. on car 1. The train was charged with the brake valve in running position. When the first car of the train was charged to 70 lb., an attempt was made to raise the pressure to 85 lb. by placing the brake valve handle in full release position. After more than 20 minutes the pressure became stationary at 82½ lb. By means of the orifice, the yard plant apparatus and the Toolometer, it was found that 50.4 cu. ft. of free air per minute was required to maintain the total train leakage under these conditions.

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*Supervisor Air Brakes, New York Central Lines, Cleveland, Ohio. From a paper before the Central Railway Club

It was then concluded that the total leakage rate of 41 cu. ft. of free air per minute at 70 lb. pressure on the first car was too great. The orifice was therefore replaced with one of ¼-in. diameter. This showed that 70 lb. could be maintained on the first car with an 80-lb. yard pressure, with a total leakage rate of 35 cu. ft. of free air per minute. The pump-up test was then repeated and the brake pipe pressure on the first car was raised from 70 lb. to 85 lb. in about 15 minutes, thus showing that the ¼-in. orifice was suitable.

Other tests were made to show how time could be saved in charging the train by placing the brake valve in the release position until the train had been nearly fully charged, then moving it to a running position, thus bringing the feed valve into operation so that it would not be overcharged. Tests were also made to determine the best way of handling the yard charging orifice. The Toolometer readings were checked and found to be sufficiently accurate.

The ordinary method of measuring brake pipe leakage on trains is not an accurate check on the total amount of train leakage which the compressor on the locomotive must be able to supply if the train is to be handled successfully.

The method suggested for measuring the total leakage by charging the train through an orifice supplied with a fixed pressure does not afford an accurate means of measuring the total train leakage.

If the maximum permissible amount of train leakage is fixed upon, an orifice size can be determined which when supplied with a constant pressure of 80 lb. from a yard plant will just supply the necessary amount of air to the train to maintain the leakage specified.

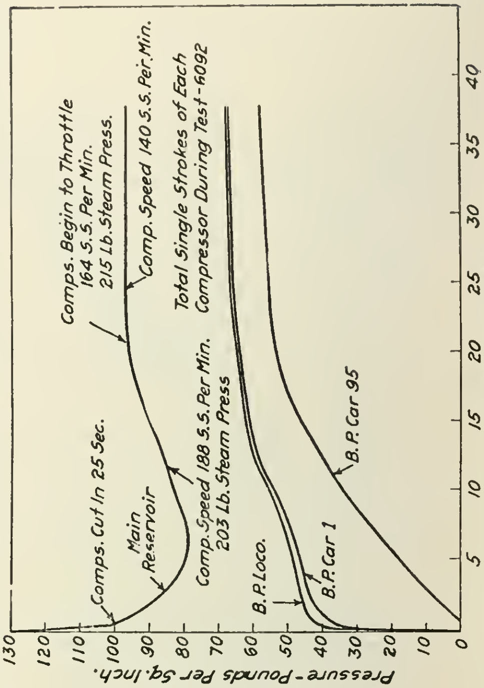

FIG. I

Such a charging orifice can conveniently be used while charging a train from the yard plant and it will afford a means for accurately determining whether the total leakage of the train is less than, equal to or greater than the maximum permissible leakage.

The best method of manipulating the charging orifice test apparatus is for the operator to start the test with the by-pass around the orifice open and then as the train charges gradually close this by-pass so as to maintain 70 lb. brake pipe pressure on the first car of the train. This method will accomplish the charging of the train in a minimum of time and avoid any objectionable overcharging.

The foregoing seems to point out the necessity of a better brake maintenance and a better initial installation of the brake apparatus; this has particular reference to securing the reservoirs and cylinders to the car body and proper clamping of the brake pipe. A large majority of the leaks are due to loose reservoirs, cylinders, and brake pipes. Tightening of the unions when these parts are loose only affords temporary relief. More attention should be paid to hose couplings when mounting hose, as many are found that do not gage and when coupled, leak.

A recent investigation of 12 trains, varying from 80 to 114 car per train, showed a loss of air from 30 per cent. to 93 per cent. of the compressor capacity. Losses of this kind are not only expensive in compressor maintenance and coal consumption, but cause serious delays to traffic.

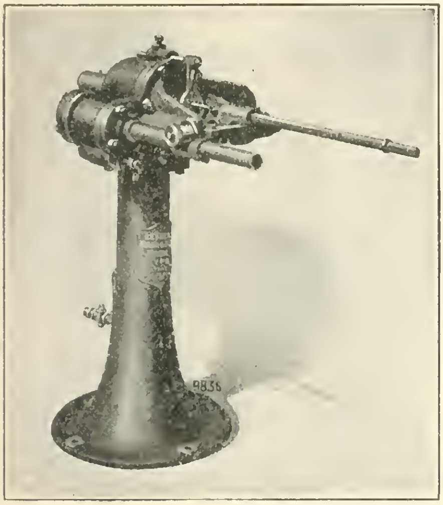

FIG. 1

A NEW LEYNER MACHINE FOR PUNCHING OUT THE BITS AND SHANKS OF HOLLOW DRILL STEEL

The modern hammer drill, using hollow drill steel and air or water to expel the cuttings from the drill hole is today the rule rather than the exception in practically all rock drilling operations. There is more or less carelessness in the matter of keeping the hole in the drill steel properly opened. Plugged steels, wholly or in part, prevent the proper functioning of the drill. Drilling speed is retarded, water tubes are bent or broken and time is lost in tinkering, or, as often happens, the drilling gang is idle while someone makes a trip to the shop for another drill steel or water tube.

To relieve this condition, the Ingersoll-Rand Company has developed and is placing on the market, as an auxiliary to the Leyner Sharpener, a new device, here shown, the Leyner Shank and Bit Punch.

This compact and simple machine consists principally of a cast iron pedestal on the top of which are bolted the clamping and punching cylinders and apparatus. The drill steel is clamped by two jaws brought together by the movement of a pinion, operated by the clamping cylinder through the medium of a rack on the extended piston rod. The heat treated steel punching pin is attached to the piston of a punch-operating cylinder, and in such manner that it may be readily removed should occasion require. The front head of the punch cylinder is provided with a clearance space around the punching pin so that on the extreme reverse stroke air is exhausted against the heated pin, effectually cooling it. The maximum stroke of the punch is 6 inches. An adjustable stop for the drill steel is provided to regulate the distance to which it is desired to have the pin penetrate. The standard punching pin is $^5/_{16}$ in. diameter for a distance of 2 in. from the end and ⅜ in. for the remainder.

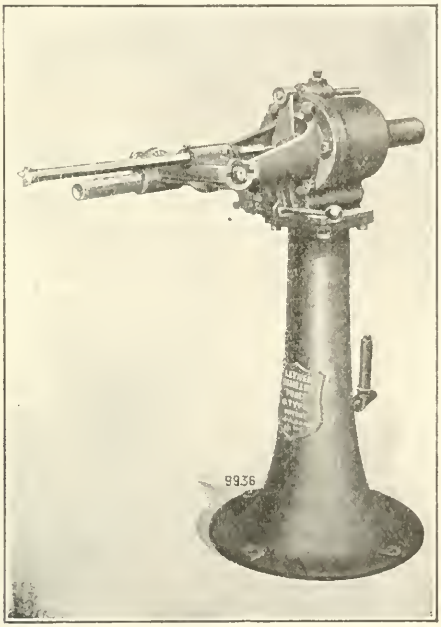

FIG. 2

The operation of the machine is controlled by a single lever moving in a T slot. A downward movement clamps the steel and a further slide movement operates the punch. The operation of the control lever locks the clamp jaws before the punch can be brought into action. In like manner the punching device must be in neutral position before the clamp jaws can be opened. This safety feature prevents action of the punch before the steel is firmly clamped and in perfect alignment. It will be noted that all moving parts are protected from dirt, grit and damage by tight fitting covers and likewise the operator is guarded from injury. The machine occupies a floor space 22x44 inches and weighs 400 lbs. A Planking support is the only foundation needed.

HIGH EXPLOSIVES IN METAL MINING

That the metal mining industry is the largest user of high explosives is indicated by the following table of two groups of mining States:

	Alaska, Idaho, Oregon, and Washington, lb., 1916	Arizona, California, and Nevada, lb., 1916
Mining other than coal	8,563,685	25,527,705
Coal mining	464,210	2,000
Railway and construction	3,573,626	3,386,302
All other purposes	7,418,382	5,407,046
Michigan		29,691,122
California		13,942,000

The relative magnitude of the metal mining industry in different States may be inferred from the following arrangement for the year 1916, the figures coming from publications of the Bureau of Mines.

Michigan	24,691,122
Missouri	24,875,757
California	13,942,000
Arizona	13,002,555
Minnesota	10,220,182
Montana	9,162,385
Colorado	8,826,030
Nevada	7,378,443
Washington	6,546,844
Alaska	5,761,280
Utah	5,133,090
New Mexico	3,061,951
Oregon	2,578,689
South Dakota	2,272,840

A DRILL RUNNER'S TROUBLES

The ground is hard as the devil.
The steel wont cut it at all;
The smith knows nix about temper.
The boss ought to give him a call.

One piece is hard and so brittle,
The next one's as soft as lead.
If he don't give us stuff we can work with
I'll crack a length over his head.

My pardner blocks up like a farmer.
The bar's coming down by the feel,
The air and the water hose leaking
Make me most as wet as a seal.

The machine takes oil like a furnace.
And blows it all over the face;
Some sucker has lugged my wrench off
And left an old bum in its place.

The round wont come to the tally.
It's a cinch that the shifter is sore.
If the mucks had got the dirt out
We'd have finished it long before.

The powder and caps are rotten.
The fuse is a genuine fake,
The air is chuck full of water,
And the blasted ground wont break.

There's no use swearing your life out.
This job is awfully tough,
But I think it's time to stop her,
I guess she is in deep enough.

B. A. PRICE, in the
Mascot Concentrate.

This summer 13,000 tons of coal, or 350 carloads, were floated down the Ohio River to Cincinnati by means of an artificial flood. Dams on the various tributary rivers were opened until an artificial crest of from three to six feet was formed, which was sufficient to float the fleet of barges.

A TRUE OLD FRIEND

Enclosed find Three Dollars ($3) for which please send me Compressed Air Magazine for three years. I have taken the Magazine for, I think, fourteen years.

Yours truly,
George R. Davis.
Parkers Landing, Pa.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

Established 1896

W. L. SAUNDERS, - - - Editor
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WHY WE ARE AT WAR

Germany has forced America, as it has forced practically the entire world, to defend itself by arms. We are fighting this war because Germany made war upon us. America is a peaceful Nation; we have no lust for conquest, no desire for annexation of territory; we are defending ourselves against Germany because the Imperial German Government entered upon a program which meant the destruction of all American institutions.

When we finally recognized that Germany was waging war upon us we had seen more than 225 Americans, among them many women and children, killed by German submarines; hospital ships had been sunk and unfortified towns had been bombed and bombarded. Medals had been struck in honor of the sinking of the *Lusitania*, the murderous act by which so many of our men, women, and children, lost their lives. German officials had treated the United States, a neutral nation, as an enemy. Strikes were organized in this country, plants were blown up, pro-German publications were founded and subsidized, and hatred of America was systematically sought to be inculcated among our foreign-born inhabitants. Every effort was made to involve us in trouble with Japan and Mexico. Our repeated protests were met with promises and explanations which were little better than insults.

The Imperial German Government finally proclaimed the unrestricted destruction of neutral ships upon the high seas. It was the notification to the United States that our people were no longer sovereign, and that if they would sail the seas in safety we must conform to conditions laid down by a Government that defied international law, humanity, and elemental morality.

A policy of terrorism has been systematically applied by the Imperial German Government since the outbreak of the European war. Treaties that stood in the way of German militaristic plans have been disregarded, women and children have been treated with indescribable brutality, the noblest works of art have been destroyed, and prisoners have been abused and maltreated and civilian populations massacred and deported.

This is why America has gone into this war in defense of American honor and American rights. To have done anything else would have been to surrender our sovereignty, and we would have been forced in the end to fight a conscienceless and rapacious military autocracy—an autocracy which is in this war avowedly for indemnities, aggrandizement, and the control of the world. Our success means that our children and our children's children will be able to enjoy peace.

Buy a Liberty Bond, get behind your Government, and shorten this war. This is your fight. Our men are giving their lives; you are only asked to lend your money. There should be at least one Liberty Bond in every home. There is no better test of your Americanism.—*Bureau of Publicity, U. S. Treasury Department.*

SAVING COMPRESSED AIR

Compressed air costs money and, like everything of value, it can be used economically or it may be wasted, the latter prevailing much too generally, and making especially pertinent the following timely words from *Railway and Locomotive Engineering.*

While the wise spirit of economy is in our midst we take it upon us to state that in the use of compressed air in railroad repair shops we have observed a tendency to extravagance, a disregard of the quantity of air used for any operation, as if its cost were a negligible quantity. The general impression seems to be that air is cheap. This is true as far as ordinary atmosphere is concerned. As a motive power, the air quiescent or moving in currents costs nothing. But when it comes to forcing the atmosphere into smaller bulk in order to increase its pressure the cost is much greater than is generally imagined.

The equivalent, or even greater, in steam pressure, must be first used in compressing the air. The action of complex machinery under the best conditions involves considerable loss in friction. To this must be added the loss in heat and in steam pressure caused by exhausting at considerable pressure. This is increased as the compression of the air approaches the limit of capacity of the enclosing apparatus. The loss by leakage is also considerable, and much of each of these losses cannot be avoided.

An important loss, however, often occurs in the filling of a larger portion of the air hoist cylinder that does not represent any portion of the lift. It can be readily seen that if the piston is raised a considerable distance before it begins to lift the desired load the space in the cylinder must necessarily be filled with air at a high pressure before any work begins to be accomplished. All lifting should begin, if possible, with the piston at the end of the cylinder.

Many of these hoists are now placed in a horizontal position, and by a clever arrangement of pulley, furnish a multiplying point very suitable for light work. At the same time close attention should be given to the economical use of compressed air. Its cost is much greater than steam. The real advantage in the use of compressed air being that it remains cool, so that attached appliances can be handled with a degree of safety impossible in the use of steam.

NEW BOOK

Compressed Air Practice in Mining. By David Penman, London. Charles Griffin & Co., Ltd., Philadelphia: J. B. Lippincott Co. 228 pages 6 by 8 inches, 113 illustrations, $1.75 net.

The author of this book, who is a Certified Colliery Manager and Lecturer in Mining and Engineering at Fife Mining School, has prepared an original work and not a compilation of builders' catalog material. Though normally designed for the use of students in mining schools and colleges it should appeal to all who are interested in the subject. Dealing mostly with English mining practice it may suggest some comparisons to the cisatlantic reader. The general principles involved in the compression, the transmission and the employment of compressed air are discussed and the entire range of practice is very completely covered.

NEW PUBLICATIONS OF THE BUREAU OF MINES

BULLETINS

Bulletin 120. Extraction of gasoline from natural gas by absorption methods, by G. A. Burrell, P. M. Biddison, and G. G. Oberfell. 1917. 71 pp., 2 pls., 17 figs.

Bulletin 138. Coking of Illinois coals, by F. K. Ovitz. 1917. 71 pp., 11 pls., 1 fig.

TECHNICAL PAPERS

Technical Paper 147. Absorption of methane and other gases by coal, by S. H. Katz. 1917. 22pp., 4 figs.

Technical Paper 149. Answers to questions on the flotation of ores, O. W. Ralston. 1917. 30 pp.

Technical Paper 150. Limits of complete inflammability of mixtures of mine gases and of industrial gases with air, by G. A. Burrell, and A. W. Gauger. 1917. 13 pp., 2 figs.

Technical Paper 156. Carbon monoxide poisoning in the steel industry, by J. A. Watkins. 1917. 18 pp., 1 fig.

Technical Paper 169. Permissible explosives tested prior to March 1, 1917, by S. P. Howell. 1917. 19 pp., 1 fig.

NOTE.—Only a limited supply of these publications is available for free distribution and applicants are asked to cooperate in insuring an equitable distribution by selecting publications that are of especial interest. Requests for all papers can not be granted. Publications should be ordered by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

RAPID DRIFTING

Drifting in solid rock is very different from, and in fact the very antithesis of, drifting at sea, although the movement in the latter case is likely to be much the more rapid of the two. The following is the story of rapid drifting of the former type as told in *Engineering and Mining Journal* by Mr. Axel Peterson, General Foreman, Arkansas and Arizona Copper Company, Jerome, Arizona.

During June, 1917, the 1601 drift on the 16th level of the Arkansas & Arizona mine at Jerome, Ariz., was advanced 535 ft. The formation was diorite for 300 ft. and medium-soft Yavapai schist for the remainder of the distance. All the ground was hard enough to stand without timbering. The diorite drilled much more slowly than the schist, but was blocky and broke better.

The drift was carried 5x8 ft., and an average of sixteen 8-ft. holes was drilled each round. The drilling was done with two No. 148 Super-Leyner drills, using 1¼-in. steel, and mounted on a crossbar. Air was delivered to the drills at a pressure of 110 lb. The drills gave perfect service, and not a minute's time was lost on their account; the only parts replaced during the month were the water tubes. Three shifts per day were worked, and each shift drilled and shot a round. The crew on each shift consisted of three machinemen, three muckers and two trammers, and besides there was a foreman and two track and pipe men on the day shift, making a total of 27 men. An average of 30 cars (19 cu.ft. each) was mucked each shift; the smallest number ever handled on any one shift was 24 and the most 42. The distance trammed was 1500 ft. at the start, and of course increased with the advance to the maximum of 2035 feet.

The order of work was for the machinemen to muck back a space about 6 ft. long at the face, and down within 1 ft. of the bottom; then they set up the drills and put in 13 holes. By the time that was done the muckers had the muck all out, and the drills were then torn down and reset in the bottom and three mucker holes drilled. A 40 per cent gelatin powder was used, and the average charge took 75 lbs. Ventilation was secured with a No. 5½ Root blower running as an exhauster and sucking through 3500 ft. of 15-in. and 12-in. pipe. Five minutes were usually sufficient to clear the fumes from the face so that all holes could be reloaded and shot which had not broken at the first shooting; and 15 minutes always cleared the drift completely so that the succeeding shift could begin work.

ADVANTAGES OF BLAUGAS

Under the Pintsch system, oil is distilled in retorts at a temperature of 900° to 1,000° C., (1652 to 1832 F.) producing as large a quantity of fixed gas as possible. Herman Blau has modified this system, however, by maintaining the temperature of the retorts at about 500° or 600° C., (932 or 1112 F.) thus preventing the production of a large percentage of fixed gases. The gas thus obtained is washed, scrubbed and purified as usual and stored in a holder. From the holder it is drawn into a three or four-stage compressor. Those hydro-carbons that would condense under normal conditions, and hence are not desired in the final product, are removed during the first and second stages of compression while the remainder of the gas is compressed in the remaining stages of 100 atmospheres.

The tar obtained from the gas is used under the retorts, and the permanent gases which the liquefied hydrocarbons have been unable to absorb are stored in large cylinders for use in the engines supplying power to the plant.

The final product, consisting of liquefied hydrocarbons and hydrocarbon gases absorbed by them, remains liquid as long as it is kept under compression, but changes at once to a gas upon relief of pressure. At 100 atmospheres the gas is reduced to 1/400 of its volume; its specific gravity is about that of air; and it has a calorific value of 1,800 B. t. u. per cubic foot.

The explosive limits as compared with other gases are as follows, the figures being percentages of gas in the mixture:

	Per Cent.		Per Cent.
Coal gas from	6.33	to	19.33
Acetylene from	2.00	to	49.00
Hydrogen from	9.50	to	66.30
Blaugas from	4.00	to	8.00

Other figures read as follows:

	Hydrogen	Acetylene	Blaugas
Cal. value, B. t. u.	425	1,500	1,800
Contents of 1 cu. ft. retainer, cu. ft.	120	100	200
Weight of retainer to transport, say, 540,000 B. t. u., lb.	1,060	432	100
Price per 100,000 B. t. u.	1.41	1.00	0.40

Blaugas is transported in steel cylinders of various sizes, the most common being one cubic foot. This cylinder when properly filled contains about 20 pounds of Blaugas which will be converted into 250 feet of expanded gas. Blaugas contains no carbon monoxide and is, therefore, non-poisonous. It is used extensively for welding and cutting, brazing soldering and laboratory purposes, and also in districts where city gas is not available.—*Gas Record.*

INCREASED EXPORTS OF U. S. MANUFACTURES DUE TO THE WAR

Seventy-eight per cent. of the more than six billion dollars' worth of American goods exported in the fiscal year 1917 consisted of wholly or partly manufactured goods. In 1914 the last normal year before the war, the percentage of such goods exported was only 59, according to a statement issued by the Bureau of Foreign and Domestic Commerce, of the Department of Commerce.

In 1914 exports of manufactures ready for consumption were valued at $724,908,000, or 31 per cent. of the total exports, while in 1917 their value reached $2,943,923,212, or 47 per cent of the total. Manufactures for further use in manufacturing were exported in 1914 to the value of $374,224,210, or 16 per cent of the total, whereas $1,191,787,957 worth, or 19 per cent of the total, was exported in 1917. The exports of food-stuffs partly or wholly manufactured amounted to $293,218,336 in 1914, or 12½ per cent of the total, and in 1917 to $739,037,884, or 12 per cent of the total.

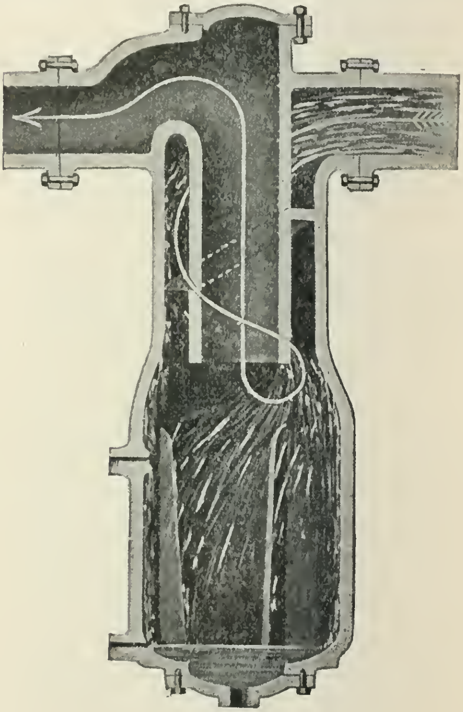


FIG. 1

THE STRATTON AIR SEPARATOR

Readers of Compressed Air Magazine must by this time be tolerably well informed that to have dry compressed air which can be used without more or less inconvenience it is necessary to take the water out of the air after it is fully compressed. The passage of the air through an aftercooler or the conveyance of the air through suitable pipes for a sufficient distance brings the air into a suitable condition for giving up most of the water it contains, but up to this point the water is still in the air, having merely been condensed but not eliminated.

The condition of the compressed air with the minute globules of water in suspension is

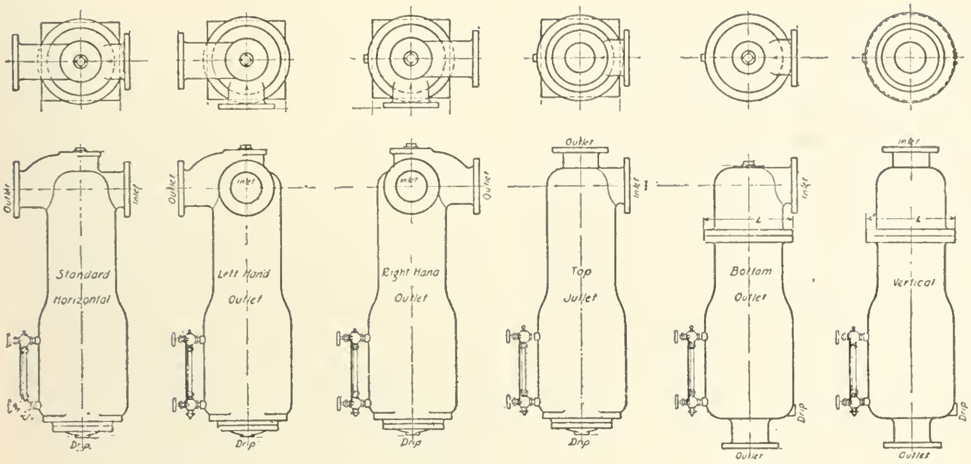


FIG. 2

strikingly similar to that of "wet" steam and it might be safely assumed that a separator which had proved itself efficient in the "drying" of steam would be equally so in the drying of air, and this is the record of the Stratton separator here shown.

As will be seen from the sectional view, Fig. 1, the separator utilizes the action of centrifugal force as the means of separating the water from the air. As the air with its content of condensed vapor enters the separator it is caused to travers a helical path leading around a central core, and the sudden change from the straight line flow imparts a whirling motion to the mass. As the water is several hundred times heavier than the air it does not follow the turn so easily but is thrown with force against the outer wall and adheres there to slowly trickle down and accumulate in the receptacle at the bottom, while the air makes the turn easily and passes on its way without the water.

The Stratton separator, made by the Griscom-Russell Company, 90 West Street, New York City, is coming into general use in compressed air lines, its operation having proved highly successful. It is made in all sizes according to requirements and Fig. 2 suggests the various arrangements of inlet and discharge to suit different piping conditions.

Extension of a branch of the Siberian Railway for 500 miles has opened one of the world's greatest coal fields.

AERATING THE SOIL

There is no question about the necessity for air in the soil, not only to supply the beneficial bacteria and plant roots but also to play its part in the complex chemical reactions which take place in the soil. It is particularly necessary for the nitrogen-gathering bacteria since their only source of the valuable nitrogen, which is to be supplied by them to legumes (such as cowpeas, velvet beans, alfalfa and soy beans) and to the soil itself (by the azotobacter organism), comes from the soil air which under normal conditions circulates in the upper six or eight inches of the soil.

The first step of course is drainage. But drainage alone will not sufficiently alter the texture of compact soils. The next steps are to gradually deepen the tillage of the soil and at the same time to add great quantities of organic matter. In plowing deeper than ever before care should be taken not to plow too deeply at one time. This is best done in the fall or winter in preparation for corn, plowing about two inches deeper than heretofore. This land should be left-rough-plowed for a month or two to expose the new inert soil to the action of the weather. At the same time a heavy growth of peas or velvet beans may be turned under. Where new soil has beeen turned up in this way and after it has beeen worked down, a very light dressing (say about 3 tons) of stable manure will inoculate it with beneficial soil bacteria and increase its productivity materially. Land handled in this way may be gradually deepened to the limit of economical tillage.

The use of power machinery will increase this depth and at the same time increase the producing power of the soil and make it more drought-resistant. Practically any kind of crop stubble or residues are valuable as organic matter for this purpose and manure mixed with a quantity of straw or similar material (even sawdust in moderate quantities) is highly desirable. Besides these factors, plenty of the right kind of cultivation at the right time is essential. Cultivation keeps the soil open so that the air can circulate freely in its upper layers.—*Louisiana Planter.*

NOTES

That from 5,000,000 to 6,000,000 cu. ft. of natural gas is going to waste daily in Kansas City because of leaky mains of the Kansas City Gas Company was the charge made recently by John N. Landon, receiver for the Kansas Natural Gas Company.

Canton's noted walls, which have stood for centuries, are now being torn down in the interests of progress, and trolley lines are to be built that will completely encircle the city and give the visitor an inexpensive and pleasant means of "seeing Canton."

The people of Apolda, a big town in southwestern Germany, have as a punishment for their extravagance in the use of fuel recently had their gas supply cut off for twenty-four hours. People whose gas bills do not show a seemly fall are threatened with having their gas meters removed altogether.

Rotting of wood, as is generally known, is caused by vegetable growths which feed upon its substance and so alter its characteristics that we say that the wood has become rotted. Ordinarily these vegetable growths are fungi, but there can be little doubt that the roots of grass and trees also attack wood in a similar manner.

Production of gasoline from natural gas increased to 38,848,144 gal. in 1916, a gain of 59 per cent. over that of 1915, and the price averaged 14 cents a gallon in 1916 as against 6 cents in 1915, making a gain of 180 per cent. in value of the gasoline produced.

One gallon of gasoline can under possible conditions render 2100 cu. ft. of air explosive.

Chicago in 1916 used an average of 620,000,000 gallons of water daily, or 249 gallons —8 barrels—per capita.

Sir Eric Geddes, recently appointed First Lord of the Admiralty, (British) began his industrial career at the age of 17 on the Baltimore & Ohio Railroad, where he remained for three years.

The Bureau of Mines, Department of the Interior, at the request of the Council of National Defense, has completed a census of mining engineers, metallurgists and chemists, with the result that 7,500 men engaged in mining and 15,000 men engaged in various chemical industries have been classified according to the character of work in which each one claims proficiency.

A gas well, which proved to be not a gas well, and very nearly the deepest boring in the world, has just been abandoned at Candor, Pa. It is 7,245 ft. deep, was drilled by the Peoples Natural Gas Company, and cost the owners more than $500,000.

When applying cement plaster or stucco to a base which is in the least porous, such as tile, brick, old concrete walls, floors, etc., the base must be thoroughly soaked with water before applying, otherwise the water will be drawn out of the fresh concrete before it has had a chance to set properly and the result will be a failure.

Manager A. G. Keating of the Big Jim Consolidated at Oatman, Arizona, being unable to secure a suitable engine within a reasonable time, has installed a six-cylinder, sixty-horsepower automobile engine, connected it up with the big Imperial type Ingersoll-Rand compressor, and is securing excellent results. Air is furnished for a 300 gallon per minute pump as well as for the power drills.

The New York, New Haven and Hartford Railway Company has taken steps to employ both younger and older men in the Operating Department than have been accepted heretofore. The former age limits for hiring men were 21 to 35 years. Under the new plan the limits for firemen will be 18 to 45 years, for trainmen, 18 to 50 years; and for other employees, 18 to 60 years.

The United States is the largest producer and consumer of talc in the world, according to the U. S. Geological Survey. The softness, absorptive capacity, difficult fusibility and solubility, and electric resistance of talc make it one of the useful minerals in the arts and industries. Its principal military use is to prevent sore feet among marching soldiers. Although the War has stimulated production it has not greatly increased the price.

A Bill has been introduced into the Second Chamber of the Netherlands Parliament for the draining of the Zuider Zee. It is estimated that the carrying out of the project will require fifteen years and cost over $45,000,000, of which two-thirds would be for the dam and auxiliary works and one-third for the draining. In addition, there would be works and measures of a protective nature, the cost of which, as estimated, would swell the grand total to about $90,000,000.

The Bureau of Mines has prepared specifications for Federal purchases of gasoline in the District of Columbia, according to which the color, which must be water white, is tested by inspection of a column in a four-ounce sample bottle. There must also be a total absence of acidity, which is tested by thoroughly shaking 10 cubic centimeters of gasoline with 5 cubic centimeters of distilled water. The mixture must not color blue litmus paper pink.

In a technical paper of the U. S. Bureau of Mines, Dr. J. A. Watkins states that one of the earliest symptoms complained of by those daily exposed to small quantities of carbon monoxide is persistent and distressing headache, accompanied at times, when the headache is severe, by nausea and vomiting. A peculiar feature of this symptom is that headache often does not begin until some time after exposure, that is, after the employee has left work, but in most instances it affects the individual the whole time he is at work, becoming more severe as the day wears on. Attacks of giddiness are common.

A. H. Crane, sentenced to the Nevada State Prison for burglary, found chemistry an absorbing study. All his leisure time was spent at it until he became expert. Last June he announced he had discovered a new and cheaper process for extracting oil from shale. Crane was granted a pardon at a special session of the parole board in order that he may perfect his process and superintend the erection of an extraction plant. His method of extracting oil from shale will be of great value to the government.

Investigations have demonstrated that to stop the average heavy freight train from a speed of 15 miles an hour, and to again bring it up to the same speed, means the expenditure of from 300 to 750 lbs. of coal, and this again means that if many avoidable stops are made a material percentage of profits is wasted. As a consequence schedules on well managed roads are now arranged so that there shall be as little interference with the movement of freight trains as possible, even if some passenger trains have to be inconvenienced in the process.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

SEPTEMBER 4

1,238,760. METHOD OF DAMP-PROOFING BURIAL-VAULTS. Andrew W. Graham, Buffalo, N. Y.

The method of rendering burial vaults impervious to moisture which consists in coating the walls of the vault with damp-proofing material, closing the vault hermetically, and thereafter filling the closed vault with fluid under pressure whereby to drive the damp-proofing materials outwardly into said walls.

1,238,952. DIVING-GEAR. Hermann Stelzner, Lubeck, Germany.

1,239,022. PRESSURE - REGULATING VALVE. Lucian B. McClean, Green Bay, Wis.

1,239,260. DEVICE FOR RAISING SUNKEN SHIPS. Charles H. Curtiss, Detroit, Mich.

3. A deflatable bag for raising sunken ships which consists of a water-tight and air-tight cylindrical structure, a saddle extending over said bag and secured thereto, a series of diagonal tension members extending transversely of the saddle from one longitudinal edge to the other, a series of main parallel tension members placed over the diagonal members and extending circumferentially of the air bag from one longitudinal edge of the saddle to the other, and means extending between the opposite ends of each main tension member to transmit the lifting stresses of the bag.

1,239,283. PNEUMATIC APPARATUS FOR APPLYING ROUGH-CAST OR OTHER PLASTER TO THE WALLS OF BUILDINGS OR STRUCTURES OR OTHER SURFACES. John Layng McKim, London, and John Johnston, Westminster, London, England.

1,239,407. MILKING APPARATUS. Peter Larsen, Cattaraugus, N. Y.

1,239,440. AIR AND VACUUM CONTROLLING DEVICE. Harry Hall Hess, Philadelphia, Pa.

SEPTEMBER 11

1,239,515. MACHINE FOR OZONIZING AIR. Andrew Peterson, Newark, N. J.

1,239,519. POWER - GENERATOR. Alcorn Rector, New York, N. Y.

1. In a power generator, the combination of an explosion case; a gas supply pipe, communicating therewith; means for igniting fuel in the explosion case; a suction apparatus communicating with the explosion case; automatic means for stopping supply of fuel to said casing; and automatic means for stopping communication between the explosion case and suction apparatus.

1,239,566. UNLOADER FOR COMPRESSORS. Rudolph Conrader, Erie, Pa.

1,239,567. COMPRESSOR. Rudolp Conrader, Erie, Pa.

1,239,568. RELIEF DEVICE FOR COMPRESSORS. Rudolph Conrader, Erie, Pa.

1,239,585. ENGINEER'S BRAKE - VALVE. Joseph P. Gault, Louisville, Ky.

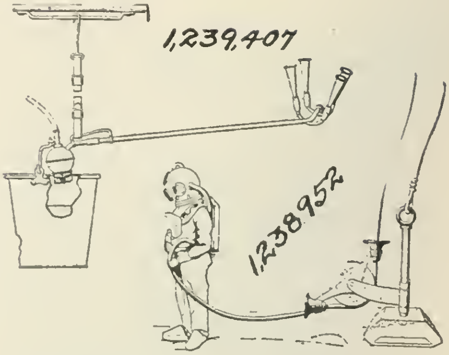
1,239,648. AIR - STARTING SYSTEM FOR INTERNAL-COMBUSTION ENGINES. William Everett Ver Planck, Erie, Pa.

1,239,673. BLAST DEVICE FOR SHOE-POLISHING MACHINES. Gustavo Espinosa de los Monteros, El Paso, Tex.

1,239,698. ELECTROPNEUMATIC ORGAN-VALVE. Halsey G. Kinder, Chicago, Ill.

1,239,776. PROCESS OF PRODUCING HEAT. Carleton Ellis, Montclair, N. J.

1. The process of producing heat which comprises injecting into a highly heated porous and permeable bed of refractory material currents of gas and air to commingle within the bed and to cause combustion to take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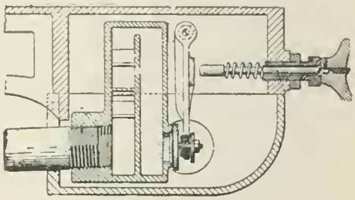
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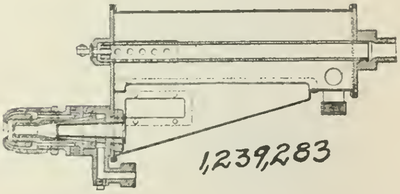
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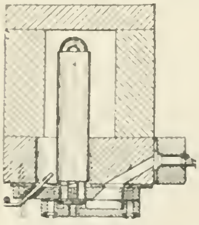
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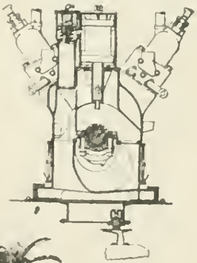
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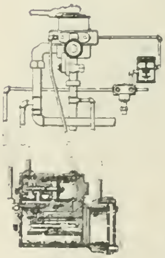
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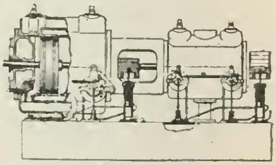
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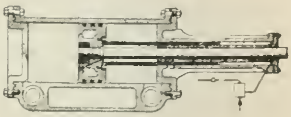
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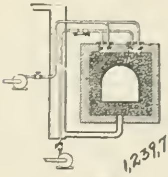
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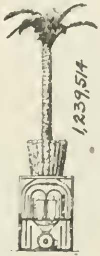
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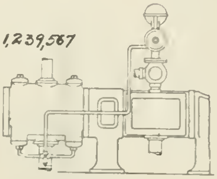
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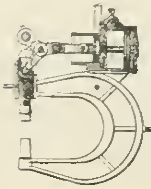
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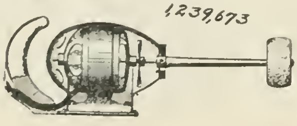
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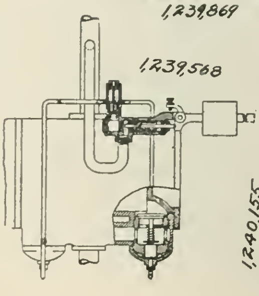
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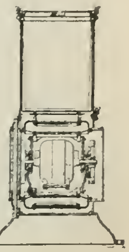

1,240,155

place adjacent the highly heated interior surfaces of the bed at the points of confluence of the gas and air, and positioning the points or places of confluence of the gas and air with respect to the preignitive characteristics of the gas and the respective temperatures of the gas and air.

1,239,815. PNEUMATICALLY - CONTROLLED BLANK-GUMMING MACHINE. Melville E. Peters, George H. Fath, and Albert F. Miller, Denver, Colo.

1,239,862. RIVETING-MACHINE. Archie M. Baird, Topeka, Kans.

1,239,869. GAS-COMPRESSOR. Louis Block, Mamaroneck, N. Y.

1,239,908. AIR - MOISTENER. Robert W. Hardie, White Plains, N. Y.

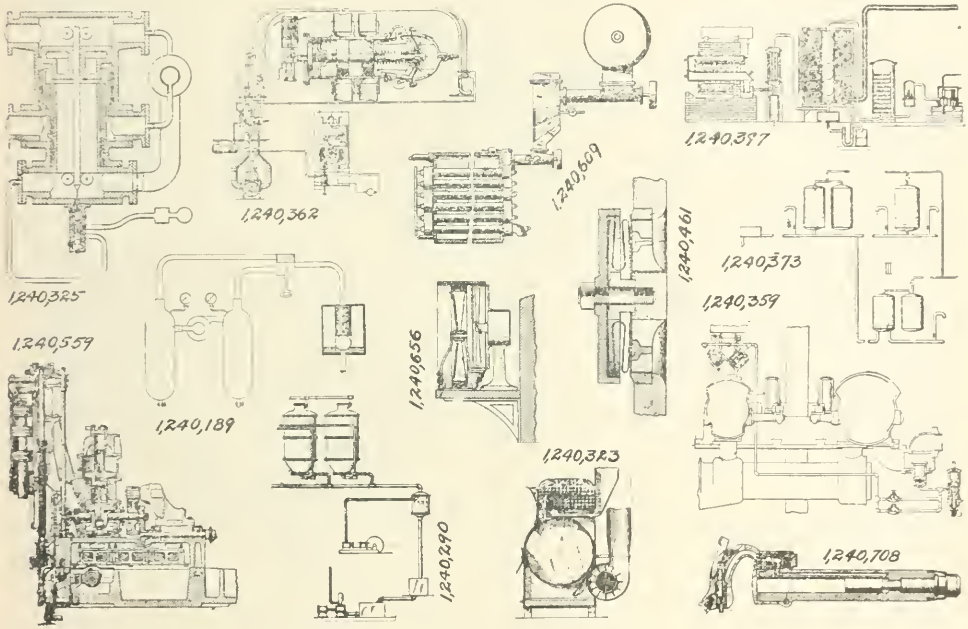
1,239,918. PULVERIZED - COAL - BURNING MEANS FOR LOCOMOTIVES. August Kirchhofer, Nashville, Tenn.

1,239,946. UNLOADING AND CAPACITY-REGULATING MECHANISM FOR COMPRESSORS. Bruno V. Nordberg, Milwaukee, Wis.

either of said first-named reservoirs in communication with said third-named reservoir for the purpose of drawing in such water or expelling it from the chest and consequently increasing or diminishing the weight of the vessel.

1,240,290. PROCESS FOR CLEANING FILTERS IN CONNECTION WITH THE PURIFICATION OF SUGAR, OILS, AND CHEMICALS. Philip L. Wooster, Yonkers, N. Y.

1. The herein described process of cleaning filter beds having a substantial depth and which are exhausted or clogged by a liquid or the solid constituents thereof, which consists in subjecting the lower portion of the filter bed having the substantial depth to the action of a suitable degree of vacuum for withdrawing the clogging material from the lower portion of the filter bed and continuing the action of the vacuum upon such lower portion to gradually withdraw the clogging material from the upper portion of the filter bed through the previously treated lower portion.



Pneumatic Patents September 18

1,240,007. DEVICE FOR PROTECTING SHIPS. Frank William Baumhover, Carroll, Iowa.

1,240,153. PNEUMATIC CUSHION FOR SHOES. George Olsen, Trenton, N. J.

1,240,155. VACUUM - CLEANER. Howard Small, Jenkintown, Pa.

SEPTEMBER 18

1,240,180. MEANS FOR RAISING SUNKEN VESSELS. Rafael de Arazoza, Habana, Cuba.

1,240,189. BALLAST CONTROL FOR SUBMARINES. Guido Fornaca, Turin, Italy.

1. Means for quickly altering the depth of submergence of submarines, comprising two reservoirs for air or gaseous fluid which are so arranged that one of the reservoirs is maintained in a condition of pressure and the other in a condition of vacuum, a third reservoir or chest in turn in communication with the sea water, and means for placing

1,240,323. DRY-CLEANING FUME-EXTRACTOR. Samuel S. Dresher, Omaha, Nebr.

1,240,325. AUTOMATIC CONTROLLING OR REGULATING APPARATUS. George Goodell Earl, New Orleans, La.

1. In a device of the class described, the combination of a plurality of fluid pressure cells provided with openings in the walls for the admission of fluid under pressure, movable means between said cells exposed to the pressures therein, guiding means for said movable means, flexible means connected to said movable means and separating said cells, and a valve and valve stem controlled by said movable means.

1,240,362. VACUUM-PLENUM PNEUMATIC-CARRIER-DESPATCH SYSTEM. Albert W. Pearsall, Lowell, Mass.

1,240,373. PNEUMATIC HYDROSTATIC SYSTEM. Adolph Roszkowski, Petrograd, Russia.

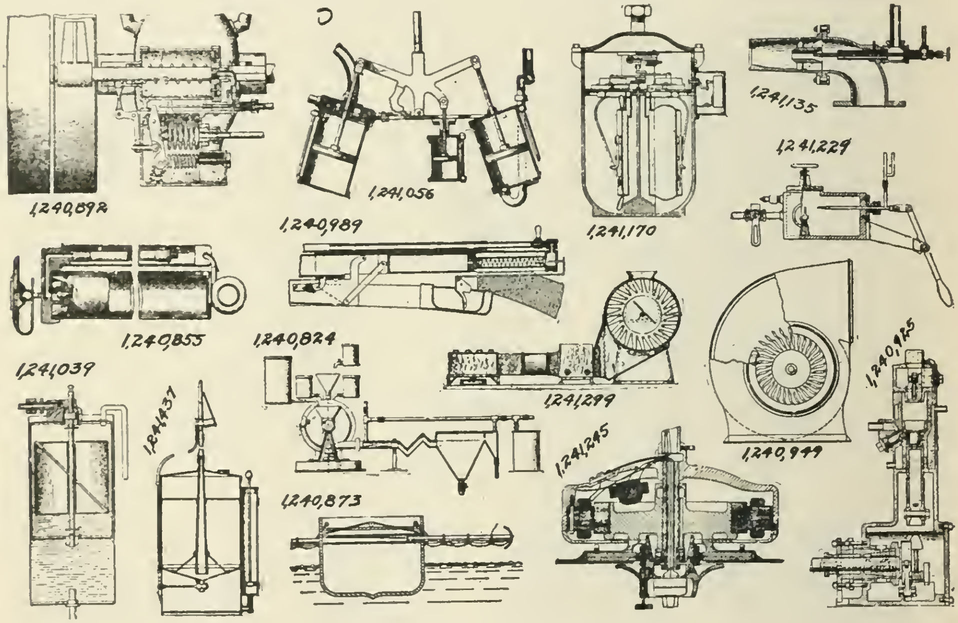
1,240,397. APPARATUS FOR PRODUCING LIQUEFIED GAS. Linus Wolf, Chicago, Ill.

1. In an apparatus for producing liquefied constituents of a gas containing hydrocarbon constituents, the combination with a cooling chamber, of means to cause the gas to pass therethrough, means to compress said gas and liquefy the liquefiable constituents thereof, and means to return a portion of the liquefied gas to the cooling chamber and to allow it to expand therein and become commingled with the gas passing therethrough whereby the gas in the cooling chamber is highly refrigerated by being commingled with the cold gas produced by the expansion of the liquefied gas.

1,240,461. VALVE FOR COMPRESSORS. Charles H. Leinert, Chicago, Ill.

1,240,531. REGULATING MECHANISM FOR CENTRIFUGAL COMPRESSORS. Otto Banner, Easton, Pa.

1,240,539. REGULATOR FOR FLUID-COMPRESSORS. Emery L. Buckley, Painted Post, N. Y.



Pneumatic Patents September 25

1,240,559. ELECTRO - PNEUMATIC CHANNELING-MACHINE. Arthur H. Gibson, Easton, Pa.

1,240,609. COOLING APPARATUS. Stewart E. Seaman, Brooklyn, N. Y.

1,240,656. AIR AND TEMPERATURE MODIFYING MEANS. Frank V. Benson and Robert Sandstrom, Los Angeles, Cal.

1,240,683. OIL-BURNER. Theron C. Curtiss, San Francisco, Cal.

1,240,708-9. PNEUMATIC PERCUSSIVE TOOL. Charles H. Haeseler, Philadelphia, Pa.

1,240,796. AIR-BRAKE-CONTROLLING MECHANISM. Thomas W. Scott, Baltimore, Md.

SEPTEMBER 25

1,240,824. PROCESS OF CONCENTRATION OF METALLIFEROUS ORES. Selden Irwin Clawson, Salt Lake City, Utah.

1. The herein described improvement in concentrating ores by the flotation process which consists in mixing the pulverized ores with a saline solution and oil, charging the mixture with gas, by throttled injection discharging the pulp thus formed into a closed separating chamber or tank, the supply of gas being sufficient to create a body of gas under pressure in the upper portion of said tank and returning the gas from the region of froth formation to the region of pulp and gas injection.

1,240,855. PUMP. Howard B. Jones, Evanston, Ill.

1,240,873. BUOYANCY ATTACHMENT FOR SHIPS. Joseph Persak, Burwell, Nebr.

1,240,892. COMPRESSOR. Stephen G. Skinner, Wilmette, Ill.

1,240,925. GAS - COMPRESSOR. Frank M. Bennett, Berkeley, Cal.

1,240,949. CENTRIFUGAL FAN. Albert A. Criqui, Buffalo, N. Y.

1,240,989. AIR-GUN. Charles F. Lefever, Plymouth, Mich.

1,241,039. VACUUM FUEL-FEEDING SYSTEM FOR GAS-ENGINES. Wilfred Shurtleff, Moline, Ill.

1,241,056. APPARATUS FOR PRODUCING ARTIFICIAL RESPIRATION. William E. Tullar, Chicago, Ill.

1,241,135. BURNER. Henry J. Mastenbrook, Lakewood, Ohio.

1,241,170. FLUID-METER. Frederick. C. Viney, Philadelphia, Pa.

1,241,229. METHOD OF SEALING GLASS BULBS. Albert J. Loepsinger, Providence, R. I.

1,241,245. MOTOR-FAN. Linus J. Parker, Fulton, N. Y.

1,241,299. DRYING APPARATUS. Gerardus Hendrikus Stroband and Johanes Henricus Stroband, Amsterdam, Netherlands.

1,241,372. APPARATUS FOR OPERATING THE BLOW-OFF VALVES OF CENTRIFUGAL COMPRESSORS OR PUMPS. Hans Guyer, Zurich, Switzerland.

1,241,437. DEVICE FOR SPRAYING POWDER AND LIQUID. John Dal Pian, Detroit, Mich.

COMPRESSED AIR MAGAZINE
EVERYTHING PNEUMATIC

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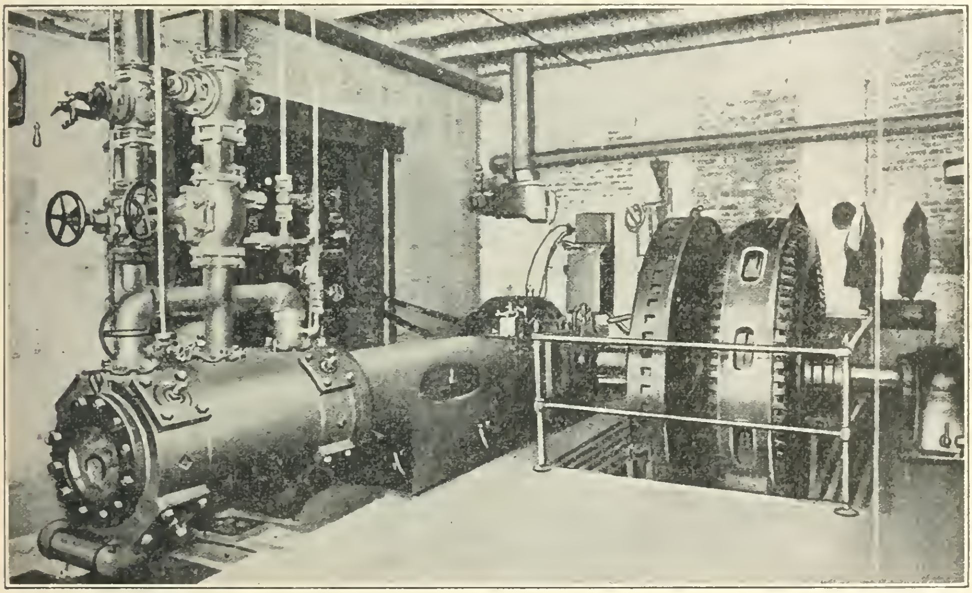


AFTER THE TRANSFORMATION

STEAM ENGINE AND GENERATOR TRANSFORMED INTO MOTOR AND COMPRESSOR

It is becoming quite difficult to find in the whole "civilized" world any human activities which have not been greatly affected or entirely transformed by the ramifications of the world-war. The half tone above, here reproduced from Electrical Review, Oct. 27, tells the story of the transformation of a brewery into an ice making plant and of the complete reversal of function of the power apparatus.

The brewery of the Gottlieb Brewing Company is on Alexander Street, Chicago, On one side of the street is the malting house, still in operation, the malt product being sold to other breweries; the old brewery building now utilized for ice making, is on the opposite side of the street.

The change at the brewery, to adapt it to ice-making, was made last winter. About two years prior to this, however, the entire industry, malting and brewing, was completely electrified. Power for this was provided for by installing two steam-driven generating units in power house of the brewery building. Within the last year it was decided to purchase electric power from the Commonwealth Edison Company, and to dispense with steam power for every purpose except heating.

The two alternating-current generators were rewound so as to convert them into synchronous motors, and the two steam engines, by which the generators had formerly been driven, were converted into ammonia compressors for ice-making.

Further details of reconstructing this part of the plant are as follows: One of the generators, a General Electric alternator, was made over into a synchronous motor by giving its rotor the requisite winding, and by furnishing the necessary parts on the switchboard to adapt it to the change; also, an additional oil circuit-breaker, with mechanical interlock, was put in. The motor, thus produced, is a 200-kilowatt, 240-volt, 480-ampere, three-phase, 60-cycle machine, with speed of 200 revolutions per minute. Belt-connected thereto is a 20-kilowatt, 125-volt, direct-current Fort Wayne exciter set.

The other generator, a Westinghouse alternating current machine, was rewound in a similar manner to convert it into a synchronous motor of 250 kilowatts, 240 volts, 600 amperes, three-phase, 60 cycles and 200 revolutions per minute. A Westinghouse exciter, belt-connected to the large motor, is a 20-kilowatt, 125 volt, 160 ampere generator, running at 200 revolutions. At present the motors are started on half-voltage taps of the main supply transformers, without the use of separate compensators.

Each synchronous motor is direct connected to an ammonia compressor which is the product of the reconstruction previously mentioned. The change consisted in taking the steam cylinder off the engine and putting in place of it a De La Vergne ammonia compressor cylinder with the necessary valves and piping equipment. The remainder of the engine—piston rod, crosshead, guides, connecting rod, crankshaft, fly wheel, bed plate, foundation—remained intact. The two ammonia compressors, thus provided, have capacities of 140 tons each, computed in tons of refrigeration.

AN EIGHT INCH WELDED GAS MAIN

The street department of the East Ohio Gas Company recently laid an 8 in. welded steel gas main on what is known as South Rocky River bridge. The county is altering this bridge which gave an opportunity to lay the pipe on the cross supports of the new walk. The work was done in record time on account of the ease of access. The length of 8 in. pipe crossing the bridge was 1,300 ft. and three expansion sleeves were inserted.

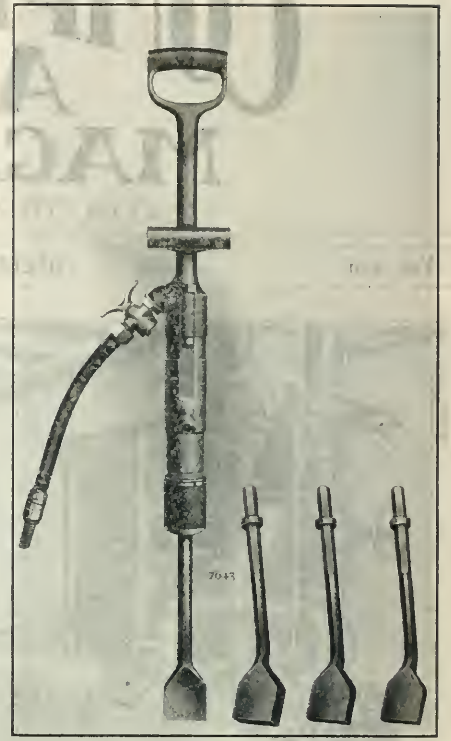


FIG. I

PNEUMATIC TIE TAMPING ON THE DELAWARE, LACKAWANNA & WESTERN R. R.

Quite a number of railroads have introduced power tamping tools into track work somewhat extensively, among these the New York Central R. R., the Lehigh Valley R. R., the Pennsylvania R. R. and the Delaware Lackawanna & Western R. R. The road last named now has its track equipped with pneumatic tie tamping machines from Binghamton to Buffalo, N. Y., a distance of 203 miles.

On this stretch of road alternate sections are equipped with tamping tools and a machine for operating four of these tools, commonly known as the "four-tool" type of machine. With this arrangement two adjacent sections alternate in the use of the machine for tamping ties in track surfacing, one of the sections using it for that purpose while the other one is renewing ties, cutting grass or other work. By such an arrangement in the distribution of work between the sections

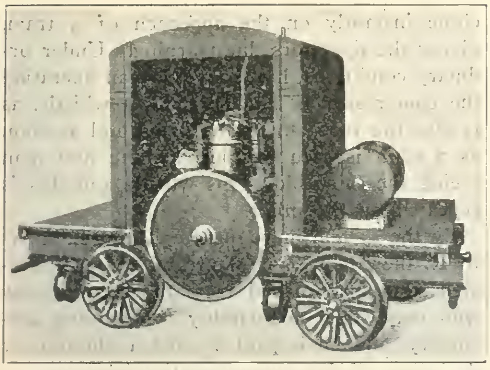


FIG. 2

one machine and outfit can conveniently serve two sections, and be shifted from one to the other, as needed. On the stretch of road named there are now 30 machines at work, and orders have been placed for 25 additional machines for equipping other parts of the D. L. & W. R. R. system.

The tools used for this work are known under the trade name of the "Imperial Pneumatic Tie Tamper," made by the Ingersoll-Rand Co., shown in Fig. 1. The tool complete weighs 37½ pounds, and with tamping bar inserted the length is 3 feet 10 inches. The air inlet is ½ inch in diameter, and the tool is fed by ¾-inch hose. The tools are designed for operation normally on air at 65 to 80 pounds pressure per square inch. The amount of air consumption, at 70 pounds pressure, is 16 cubic feet per minute.

For work in different kinds of ballast there are four tamping bars of different thicknesses, all being 18 inches long. That for broken stone ballast of 2-inch size or larger has a tamping face ⅝x3 inches. For rock ballast finer than 2 inches, washed gravel and slag, the tamping face is ⅞x3 inches. For cinders, earth, gravel, sand or chatts, the tamping face is 1⅛x3 inches. Each tamping outfit consists of tampers, a power machine, and hose connections.

What is known as the machine or power plant consists of a gasoline engine and an air compressor mounted upon a heavily constructed vehicle of the push-car type. A view of the machine is seen in Fig. 2, this being the "Imperial" gasoline-engine driven tie tamper compressor, four-tool type. The gas power cylinder and the air compressor cylinder are connected to a double-throw crank shaft. To insure correct and permanent alignment the cases which carry the crank shaft bearings are mounted on a machined sub-base. The gas cylinder is of the two-cycle type and an automatic governor controls the speed by acting on the throttle which forms a part of the carburetor. The air compressor is of the single-stage single-acting type, with inlaid valves seated on the piston and Ingersoll-Rogler discharge valve. Both cylinders and cylinder heads are thoroughly water jacketed, and a water circulating system with radiator and high speed fan, of automobile style, form a part of the outfit. In the discharge line between the air compressor and the air receiver there is a pressure-operated unloading device which automatically controls the pressure in the air receiver, keeping it within desired limits.

This compressor outfit is self-propelled, by means of a sprocket chain which can be thrown into gear by means of a clutch connection with the main shaft. The general method of operating the equipment is to set off the car, using 4x5-inch timbers faced with strap iron or light-weight rail as a cross track for the car, and rolling it onto a prepared stand made by setting four posts in the ground and cutting them off at the proper level, or on a crib of ties laid on the ground or shoulder of the roadbed at the point where it is desired to remove the car from the track. As the weight of this outfit is 3,300 pounds, jacks are used,

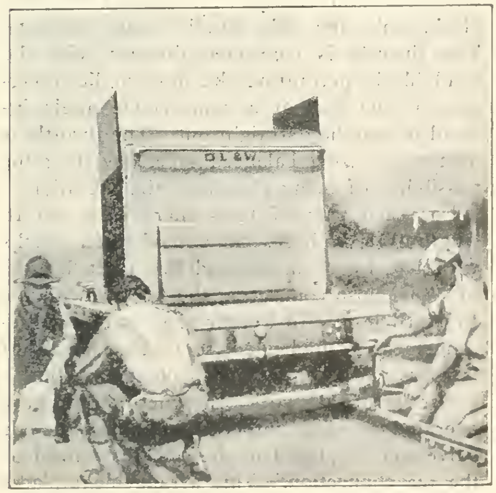


FIG. 3

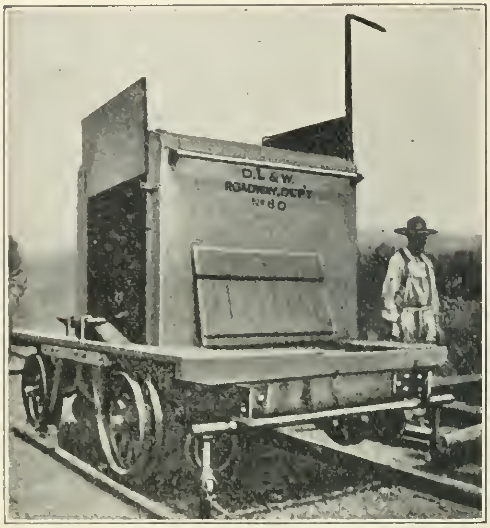


FIG. 4

Fig. 3, to lift the car far enough from the track rails to insert the cross rails underneath the auxiliary wheels, which, as will be noticed, are set at right angles to the track. Fig. 4 shows the compressor car supported on the cross rails ready for removal.

The car is made with a light sheet steel cover, which serves to protect everything from the weather and the heat of the sun and detachable doors are furnished for locking up when not in use.

The pneumatic tamper, Fig. 1, is made in one piece with the handle shaft and the head block, only the side handle being separate. The throttle is connected directly with the head block, permitting the hose to lie alongside of the tool at a comfortable angle instead of standing straight out. The throttle is of the two-wing balanced type, obviating the possibility of being closed by the vibration.

For each pair of tools there is a 300 ft. length of 3/4 in. hose, made up of 50 ft. lengths with a 3/4 by 1/2 in. tee, and two 12 ft. lengths of 1/2 in. hose connecting the tamper with the standard hose. In a four tool outfit this arrangement is duplicated. so that each pair of tampers works on an independent hose line.

For terminal work or where trains are operated at close intervals an automatic air valve can be placed in the line just ahead of the tee connection. This arrangement places the control of the machine in the hands of the lookout man, who shuts the air off the machine instantly on the approach of a train, giving the operators due warning. Under ordinary conditions, however, the man operating the compressor is supplied with a whistle, as is also the foreman of the gang, and as soon as a train is seen to approach the first man seeing the same blows his whistle and this is repeated by the other.

By the system in vogue on the D., L. & W. R. R. the compressor plant and car are operated by a man picked from the section crew who may show adaptability to handling machinery, and he is paid 2 cents an hour over the wages of the common section laborer.

The tamping tools, as in Fig. 5, are used by ordinary laborers, and they work their way down to the bottom edge without removing the ballast from the side of the tie, as is necessary in hand tamping. In its work the tool breaks up the old bed under the tie in about the same manner as the work proceeds with the use of hand tamping picks. It is the observation of the foreman that these power driven tools do the work more thoroughly than it is usually done with tamping picks or bars in the hands of the average track laborer, and the laborers prefer these tools to hand tampers for ease of handling. There is no difficulty in holding the tool to tamp directly under the rail seats, and about switch and turnout rails, frogs, and other cramped quarters.

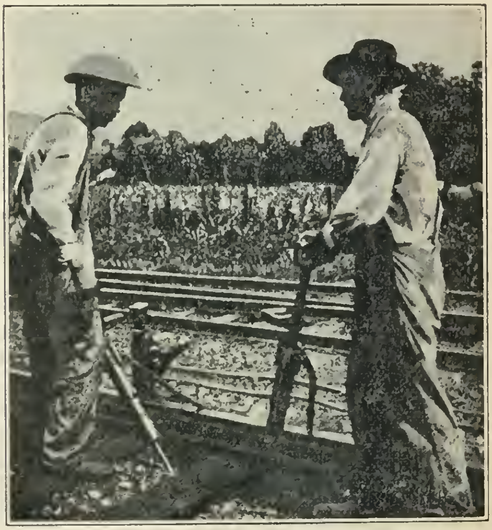


FIG. 5

The operation of the pneumatic tampers is not only more efficient but is also more expeditious than that of hand tools. A test of rate of work and costs by the two methods was made last year, in which the results of the work of five section crews at hand tamping were carefully observed and recorded for a week, as against the average results from the operation of five of the machines in regular operation. The work was in broken stone ballast, and the average cost per tie in hand tamping was 9.2 cents, whereas the average cost per tie tamped with the pneumatic tools was 5.97 cents. In the latter figure the items of fuel, repairs, wages of machine operators and foremen were taken into account, but not the overhead expense.

In all the work that is done with these pneumatic tampers accurate record of the matters of expense is kept and regularly reported, printed cards being provided for the records.

The average consumption of gasoline in the operation of a 4-tool outfit is about 15 gallons in 9 hours. It is found that with all crews the consumption of gasoline decreases as the men become accustomed to the work.

Near Hoboken, at the eastern end of the system, the air pipe lines about the terminals are availed of as the source of energy for operating the tampers, in which case, of course, no portable compressor plants are used.

At one place, near Waverly, N. Y., where there is a high fill about ¾ mile long, with shoulder width too narrow for conveniently setting off the machines without considerable preparation, an iron pipe line 1,000 ft. long is used to transmit the air. This suffices for power distribution in working over 1,500 ft. of track (double track). After such a stretch has been finished the pipe is uncoupled, in 100-ft. sections, and dragged along to an additional stretch of track, to repeat the operation. The pipe used is 1½-inch, but this has been found unnecessarily large for a 4-tool outfit.

In the development of the use of pneumatic tampers on this road, Mr. George Lowe, supervisor, at Elmira, N. Y., has taken a leading and enthusiastic part, and many improvements of machinery and method have been adopted as the result of his studies of the work. We are indebted to Chief Engineer G. J. Ray and to Mr. Lowe for an opportunity to observe the practical working of this means of saving labor on track.—*Condensed from Railway Review.*

FLYING IN CLOUDS

Personally, I seldom use an instrument as an assistance to piloting. Do not assume that I am sneering at instruments; in fact, as I have stated, there are times when they are a necessity. In fact, I am going to suggest that one instrument be fitted as a standard equipment, an instrument to reduce the risks connected with flying in clouds. It may not generally be known that there have been such a large number of fatal accidents during the last three years entirely due to flying through clouds, and I consider this subject wants going into pretty carefully.

The accidents to which I refer have not been questions of a want of height; the machines, have become hopelessly out of control. I will give you an instance which happened to myself a few weeks ago in the west of England. You will then realize why I consider this is a serious matter requiring particular attention.

I set out on a very cloudy, windy day to do a test climb to 10,000 feet on a late type two-seater. I had so often on previous occasions succeeded quite comfortably in reaching this height in spite of cloudy, overcast days by pushing up through the clouds, usually only a matter of a few minutes, into bright sunlight and the bluest of skies, and after reaching the desired height, coming down again through the clouds, having flown by compass and time.

On this particular day, however, the wind was very gusty, and on reaching 1,200 feet we got into dense rain cloud, but carried on to beyond 5,000 feet, still in the cloud, when the compass apparently began to swing (really it's the machine that begins swinging, not the compass). Efforts to check the compass had the effect of causing it to swing more violently in the other direction.

The air speed then rushed up far beyond normal flying speed; all efforts to pull her up checked her only slightly; then the rudder was tried, back went the air speed to zero; there was an unusual uncanny feeling of being detached from the machine, and I knew her to be literally tumbling about in the clouds. All efforts to settle down again to a straight flight seemed to be unavailing, until we emerged from the cloud very nearly upside down. Assuming control again was then an easy matter.

This sort of thing has happened to me more than once, and, in the Flying Corps vernacular, "it puts the wind up you." And it has happened many times with other pilots. In some cases they emerge from the clouds in a spin, others are known in which the planes have collapsed under the strain of the sudden pull-up from the vertical nose-dive.

A few days ago, a squadron commander told me that on one occasion when in France everything loose in his machine fell out while in a cloud. A week or so ago, on the South Coast, a machine disintegrated in a cloud and the main planes landed half a mile from the fuselage. From my own experience, this is a very unpleasant state of affairs, and in consequence I avoid clouds when possible.

Let us try and examine the cause of this. First of all you must realize that in a cloud you see nothing whatever but your machine around you. There is no fixed point visible. The only means by which you can tell if you are flying in a straight course is by your compass and your air speed. The compass should give you your direction horizontally, your air speed your direction vertically.

The first thing that happens, and very readily too, if windy and bumpy, is that your compass card will begin to move slightly. It really appears to you that the compass was suddenly affected by the cloud, and you are flying straight ahead. How often you hear a pilot say that as soon as he got into a cloud his compass started spinning. The moment the compass starts moving it requires extremely delicate ruddering to get it back to a steady position; in fact, one invariably over-corrects the compass movement, and so the trouble begins.

Once the compass starts on a good swing I have found it nearly an impossibility to get it steady again until out of the cloud. Before your compass starts to move, your machine has already started to turn. You rudder the opposite way to check it, over-correct it, and turn sharper the other way on to a banked turn; then the nose drops and speed goes up. Pulling back your elevator-lever has little or no effect, for if you are banked above an angle of 45 degrees the elevator becomes the rudder. All this occurs without the pilot being in the least bit aware of the position that his machine is taking relative to the ground. The instruments available are of little service once he loses his control.

Of what use is his air speed indicator to him indicating 150 m. p. h. if the machine is on a spinning spiral, and he imagines that he is merely descending too fast on a steep, straight glide? He naturally tries to pull up, but with no effect. The bubble does not help him, as centrifugal force will send that anywhere.

It may be argued that if a stable machine is left alone under these circumstances it will right itself eventually and assume a normal glide. It very likely would if the pilot could steel himself to let it entirely alone, but before it did so it would have to be left to do a sheer vertical nose-drive for some moments, and in these days of big weights and little head resistance one is liable to attempt to pull out too suddenly from the dangerous high rate of speed attained on this dive. What I want to see fitted is an instrument which will show a constant vertical or horizontal line and be independent of centrifugal force.

I have no ideas upon the subject nor suggestions as to how this is to be brought about, unless something in the nature of a small gyroscope driven by an air-screw could be employed in some way to meet the requirements of flying in clouds, but until something is provided so that the pilot can see a fixed line, I think we shall continue to have accidents from this cause. —*Captain B. C. Hucks, R.F.C., before the Aeronautical Society, London.*

BLOWING DUST FROM MACADAM

In preparing macadam roads for the application of tar or oil, it is generally desirable to remove all dust from the top of the road to permit the bituminous material to penetrate the stone. Where a portable air compressor is available, this can be done by blowing it off; which is the best way, for it cleans out the upper interstices, while brooming only packs the dust into them. One plan is to attach to the end of the air hose a T-shaped set of pipes formed of a T and three pipes, a row of small holes being drilled in line in the two pipes that are fastened in line in the opposite openings of the T. This set of pipes is held in the hand or may be fastened under the wagon carrying the air compressor so as to come an inch or two above the road surface and with the air jets making a slight angle with the vertical, blowing the dirt in the direction in which the wagon is moving.—*Municipal Journal.*

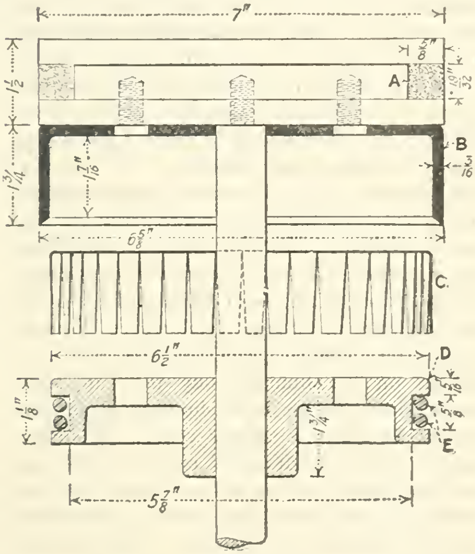
COMPRESSED AIR IN FRENCH TRENCH MORTARS

A goodly portion of the French trench mortars of today are of the compressed-air type. Instead of the usual powder charge, they make use of a puff of air or gas to propel the aerial torpedo or land mine through the air and into the German trenches.

After a lapse of some thirty years, the revival of the pneumatic cannon is apt to be hailed as a brand new idea. As a matter of fact, however, the idea is anything else but new. In several of his campaigns Napoleon encountered Austrian troops equipped with pneumatic rifes, and he is said to have seriously considered this type of weapon for his men. At various times during the nineteenth century, the idea of pneumatic cannon was suggested, and in several instances full-sized compressed-air artillery was actually constructed and tested. But with the introduction of modern explosives and propelling powders, the pneumatic cannon was laid aside as an impractical weapon. The present-day trench warfare caused the pneumatic cannon idea to be brought out into the open again, worked upon, and then introduced in the form of a highly-perfected trench mortar which meets all the peculiar requirements of the intrenched warriors.

In the present pneumatic trench mortar the propelling charge is supplied either from a tank of compressed air or gas, such as carbon dioxide, or from a tank which is charged by means of a hand-pump. In either case the tank can be used for a number of rounds before it is recharged, since only a puff is necessary to eject the projectile. In the case of the hand-pump type, 200 or 250 strokes of the pump handle are sufficient to produce a pressure of eight to ten atmospheres in the reservoir, which, in turn, is sufficient for a number of rounds. The apparatus which releases the puff of air is operated by means of a trigger or lanyard, and immediately following the release of the propelling charge an automatic valve shuts off the further escape of air or gas from the tank. Indeed, it is the mechanism which only allows a sudden puff of air or gas to be injected into the chamber of the cannon, behind the projectile, which presented the greatest problem in the development of this type of artillery.

It is reported that, aside from being silent and inexpensive of operation, the pneumatic mortar lends itself to ready manipulation. It can be handled at a fairly high rate of speed. Most important of all, however, is the fact that the aim of the pneumatic trench mortar is exceedingly accurate, provided the reservoir is not discharged below a certain point. Obviously, it is the short range over which the trench mortar must be operated, namely, 750 to 1,000 feet, which has made this form of pneumatic artillery a military success.—*Scientific American.*



AIR-HOIST PISTON PACKING

BY GEORGE W. BERSHEEE

The accompanying illustration shows a method of making an air-hoist piston and cup leather that will give good service. I have made many such for use in an iron foundry where the hoists are used to handle ladles of iron while "pouring off" machine floors. This service requires them to hold steadily at any height needed and subjects the hoist to considerable heat. The ring of square hemp packing *A* serves as a swab and distributes any heavy oil used to lubricate the piston and cylinder.

To assemble, slide the cup leather *B* into place, then the slashed sheet-iron disk *C*, and then the follow plate *D*, and tighten all with the cap screws. The ¼ in. spring rings *E* should stand open ¾ in. when spread and the ends butt when closed. Slip these into the follow-plate groove behind the sheet-iron disk and they will keep the edge of the cup leather tight against the cylinder wall all around, and the air pressure will finish the job. The piston should then slip in easily.—*Am. Machinist.*

ARIDITY OF DESERTS AND OF SCHOOLROOMS

Schoolroom air may and does contain less moisture during much of the winter season than desert air, and also has a lower relative humidity, but it does not extract so much moisture from wet objects nor from the human body. In other words while schoolroom air is drier, desert air is more *drying,* which is not the same thing. The apparent contradiction is explained by the more active movement of air and consequent more rapid evaporation outdoors than indoors. The Ventilation Commission has been measuring evaporation in schoolrooms with a Livingston porous-cup atmometer, and the somewhat surprising fact was revealed that in certain rooms where the air is artificially humidified and the average humidity is 38 per cent., there is more evaporation and a greater drying power is exerted on the human body than in other rooms where the air is not humidified and the relative humidity is 28 per cent. The difference in apparent "dryness" is due to the fact that the rooms in the former case are fan-ventilated and in the latter window-ventilated. Relative humidity by itself is a criterion of neither dryness, nor dryingness, nor the sensation of dryness.—*Mr. George T. Palmer, American Society of Heating and Ventilating Engineers.*

VENTILATION AND TUNNEL PROGRESS

Dr. A. J. Lanza of the Bureau of Mines, in a paper at the recent meeting of the National Safety Council, cited an interesting example of the effect of poor ventilation on the efficiency of men in underground work. A mine, driving a long drift about 3,000 ft. below the surface, was paying $15 per foot, day's pay. The place was hot and moist. A small blower fan was installed at the entrance to the drift, with a canvas pipe leading nearly to the working face, and without any other change the cost was reduced to $8 per foot, day's pay. In shaft sinking this mine had made 50 ft. in one month and 60 ft. in another. A small blower with canvas pipe was installed and the next month 120 ft. was the progress made.

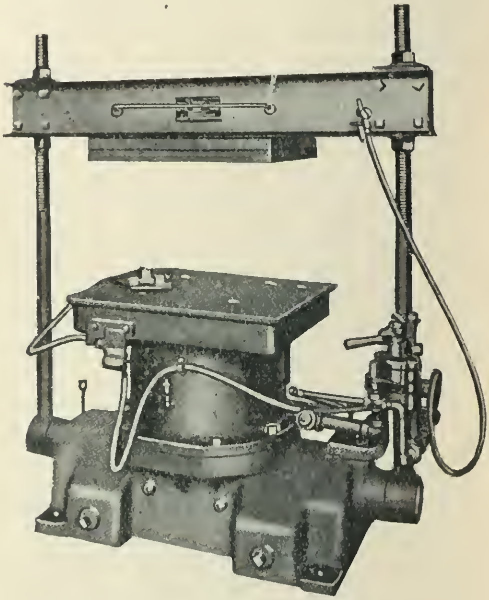


FIG. 1

POWER SQUEEZERS*

Different means have been employed to operate power squeezers and it has finally resulted in the almost universal use of compressed air for the purpose. Consequently, before installing power squeezers it is necessary to have an air compressor, the services of which will be required also for various other tools. The largest field for power squeezers is for work commonly known as bench work, for which they are specially adapted. The use of the power squeezer makes it easier to obtain and keep an operator as less physical exertion is required than with the hand operated squeezer.

Different types of power squeezers will here be spoken of in succession, beginning with the plain power squeezer with head swinging on rocking strain rods, Fig. 1. This machine operates practically the same as a hand squeezer excepting that the squeezing is done by letting air into the cylinder, thus forcing

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*From Service Bureau Bulletin, No. 7, National Founders' Association.

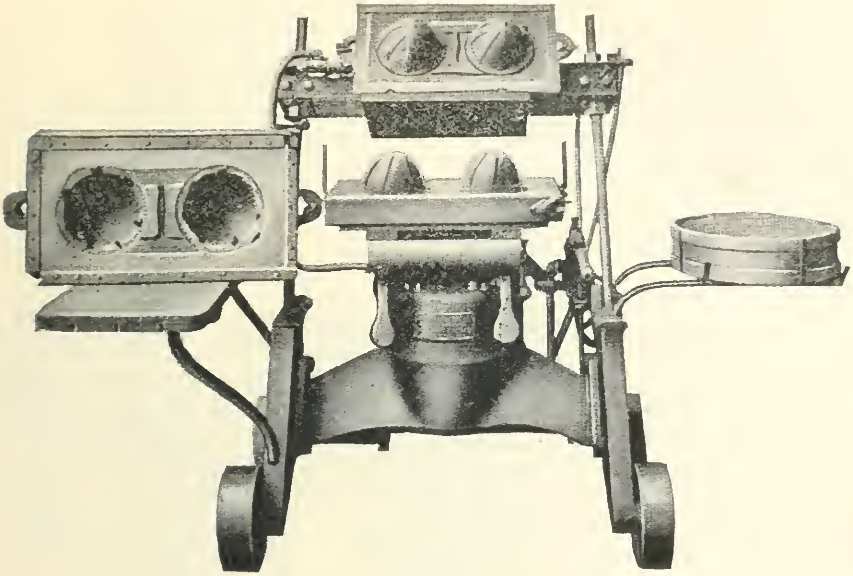


FIG. 2

the mold up against the head. The air cylinders are usually 10 in. or 12 in. in diameter. Machines of this type are designed to operate efficiently with 80 lb. air pressure. The air should be let into the cylinder slowly enough to avoid giving a ramming blow, as the steady squeeze is much better. After the mold is squeezed the air is discharged by a turn of the valve lever, and the table descends to its former position.

A modification of type one is the plain power squeezer mounted on wheels, with swinging strain rods, Fig. 2. This machine has the advantage of being easily moved from place to place in the foundry, and it can also be moved alongside the sand heap. The wheels raise the machine above the floor enough to allow space for the operator's feet and for him to shovel easily from under the machine. This machine is built also with straddle legs, Fig. 3, to enable the machine to work right over the sand pile, and is mounted on wheels so that it can be pushed forward as the floor is filled with molds. After pouring, the molds are dumped in a winrow and the sand is tempered and cut in this position for the next day.

The plain power squeezer with rotating head, Figs. 4 and 5, differs from type 1, in that the head swings horizontally out of the way instead of rotating on strain rods. The head is easily swung around into place. This type has only been in use a few years, but is meeting with considerable favor. The same pattern equipment is used on this type as on the type having the swing head on rocking strain rods, and the same comparative results are obtained. The pressing block has a steel adjusting screw permitting easy adjustment of the block to various depths of molds.

In the plain squeezer of the hinged head type, shown in two positions in Fig. 6, the head is made to swing back on a hinge or trunnion placed well above the level of the table. A strong, spring acts as a counterbalance to help carry the weight of the head. When pulled forward into ramming position

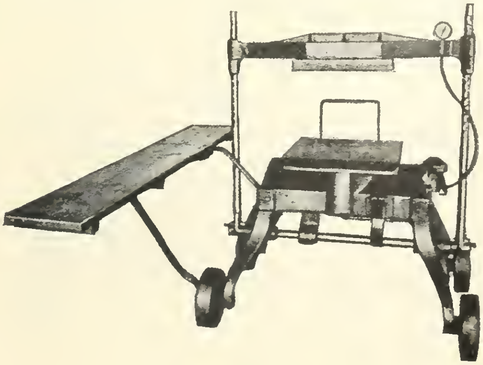


FIG. 3

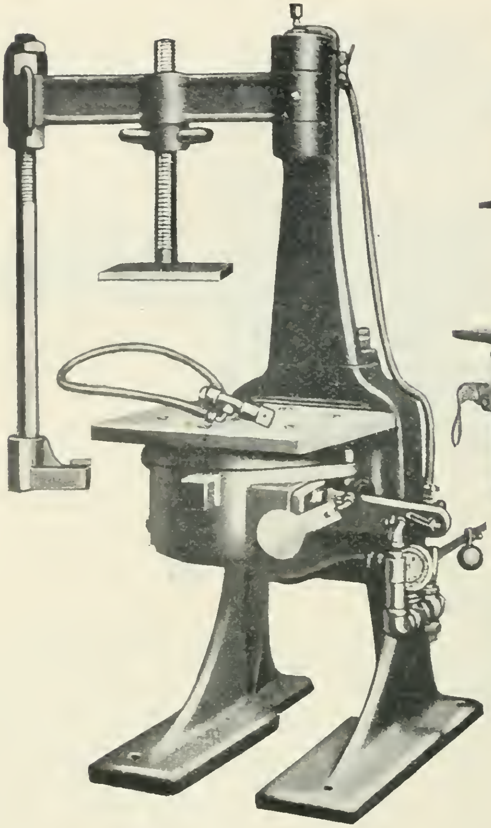


FIG. 4

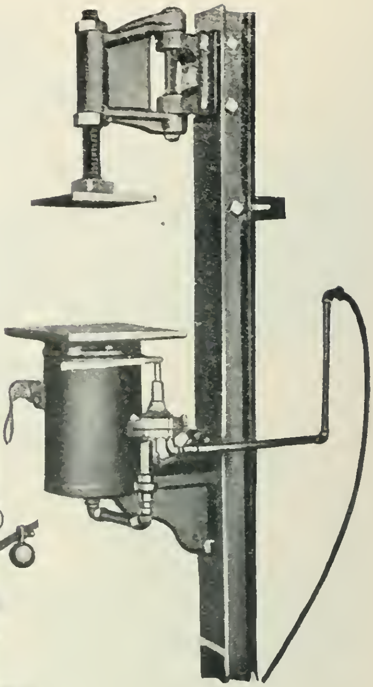


FIG. 5

the end of the strain rod falls into a lock to take its share of the ramming thrust.

Fig. 7 shows a plain power squeezer having a squeezer head operated by a compound toggle movement, the toggle mechanism being operated by an air cylinder, the machine being also provided with an air operated pattern drawing device. This machine is of more elaborate construction than those previously shown and has great adaptability. It can be used for aluminum match plates, hand sand matches, patterns on one side of the plate, on both sides of the plate, or for stripping plates.

The machine consists of a cast iron table to the frame of which is attached the pattern drawing mechanism. The tilting squeezing head is attached to a cast iron crossbar supported on rods fastened to the frame. The table is slotted to permit the passage of the pattern and flask lifting posts, and slots also are provided for the adjustment of the flask stops, which can be set for any flask within the capacity of the machine. These stops serve as guides for the operator, and after being set to the size of the flask locate the same on

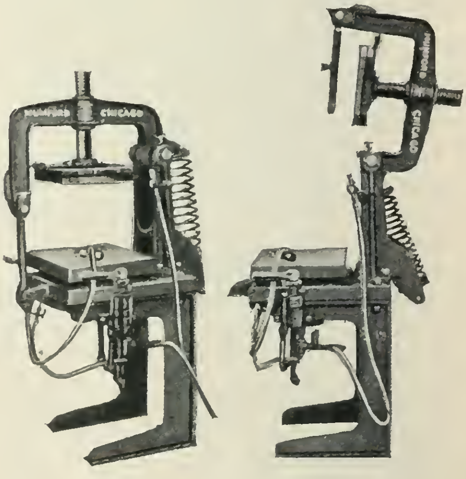


FIG. 6

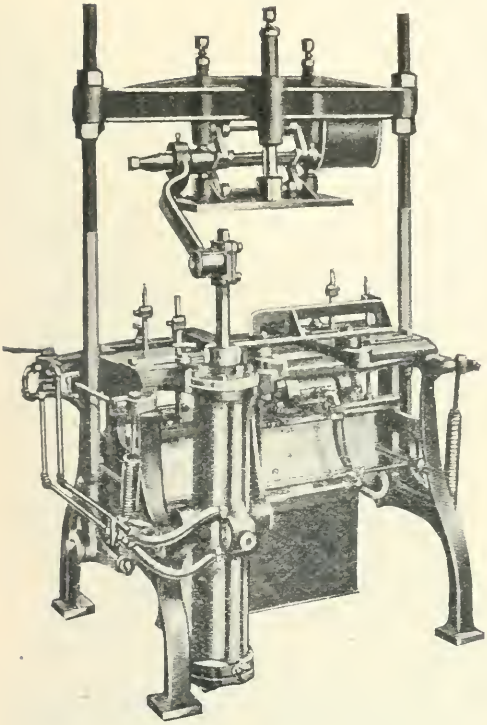


FIG. 7

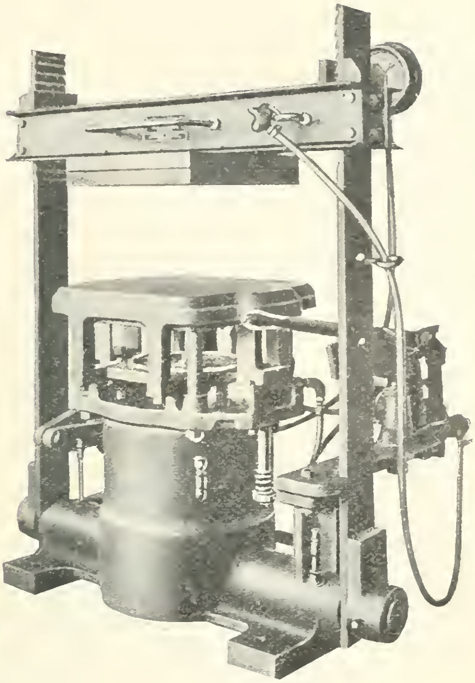


FIG. 8

the table in its proper position underneath the squeezing head. Liners also are provided for bolting pattern plates to the table. A vibrator, knee-operated, is attached to the machine.

The squeezing head has a compound toggle movement, reducing to a minimum the power required to press the mold. The greatest power is obtained at the point where the hardest pressure is required, and, as the toggles are self-releasing, it is impossible, after the head has been adjusted for the pattern to be molded, to press a mold harder than the density desired.

The head, it will be seen, is adjustable up and down. The tilting of the head is controlled by springs attached to the lower ends of the steel uprights and the frame of the machine. The lifting mechanism is controlled by the lever shown at the side, which is thrown over by the operator while vibrating the pattern with a knee valve. The post-raising lever is held until released by a spring latch.

The power squeezer, split pattern type, is built with heads of three different kinds: the head swinging on rocking strain rods, the rotating head type, and the head mounted on a carriage, the latter arrangement being

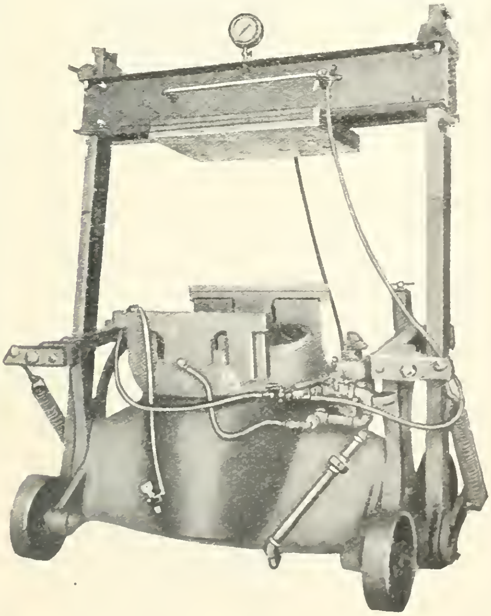


FIG. 9

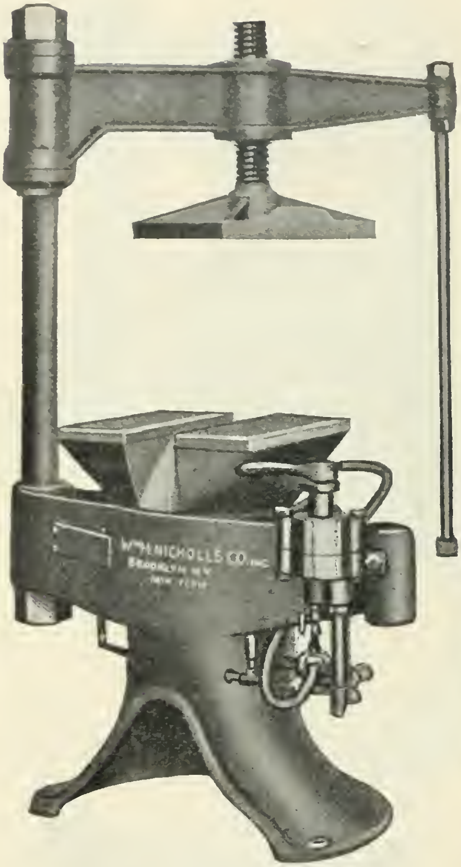


FIG. 10

shown in Fig. 8. This kind of machine has long been in use, and is one of the first types of power squeezers made. As its name indicates, it is used where the patterns are split and mounted on plates. Unlike the plain power squeezer operated with match plates, only one half of a mold is made at a time. They are extensively used in both iron and brass foundries, and are used with snap flasks or solid flasks. The machine is provided with a pattern drawing attachment, which operates to lift the mold from the plate. It is equipped with a vibrator attached to the frame or yoke which carries the pattern plate, so the pattern plate can be vibrated as the mold is lifted from the pattern. A blowoff valve also is furnished to clean the pattern plate or any part of the mold that may be necessary.

The power squeezer stripping plate machine, Fig. 9, is built with the head swinging on rocking strain rods, with the rotating head, or with the head mounted on the carriage; in fact any split pattern machine can be fitted with stripping plate patterns without difficulty.

JOLT RAMMING

The principle of jolt ramming the sand has been applied to power squeezers with all three of the head mountings which have been previously mentioned, Fig. 10 showing the rotating head. A machine of this type is adopted for use with the same pattern equipment as with the machines here first spoken of, and is particularly adapted for deep drag, shallow cope work mounted on plates. The drag is jar rammed first, the board is squeezed in place, and the cope is then squeezed but not jar rammed. This jarring principle does away with all tucking by hand, rams deep green sand cores perfectly, and produces castings true to pattern. The jolting increases the ca-

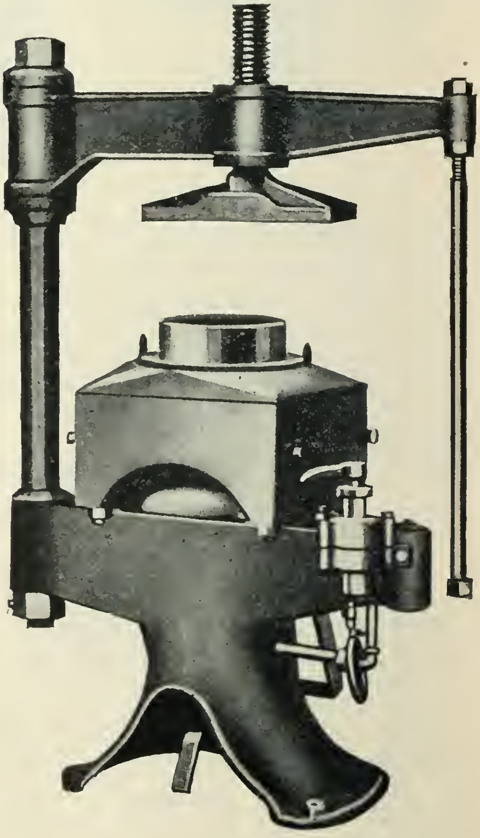


FIG. 11

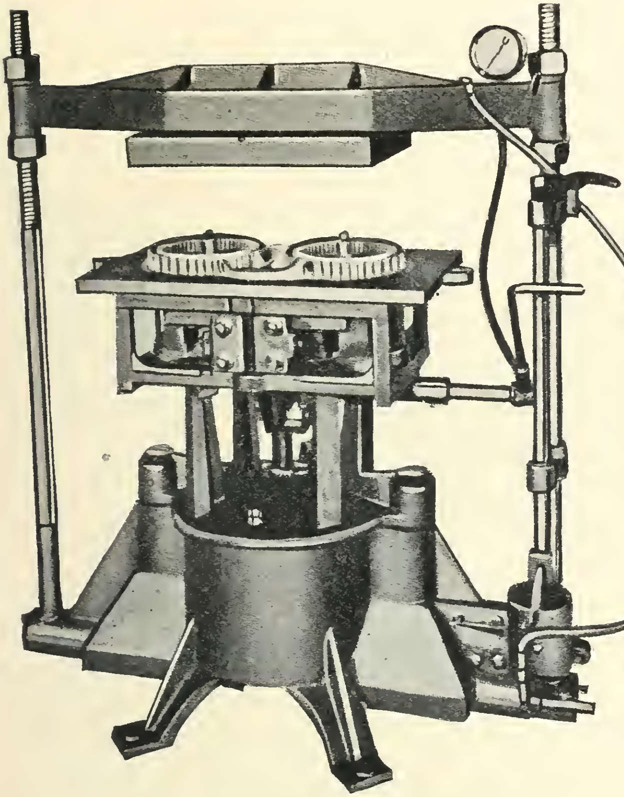


FIG. 12

pacity of the machine, as deeper flasks can be rammed than with a squeezer.

The application of the jolt ramming principle is a distinct advance, and nearly every one has now learned the many advantages of jolt ramming. This feature is added to the machine by the use of a valve which raises the table to a certain height when the valve releases allowing the table to drop and strike an anvil, or what serves as an anvil. Some makes of machines apply this principle by the use of a cylinder inside the ramming cylinder.

The power squeezer, jolt ramming, stripping plate machine is shown with the different head mountings in Figs. 11, 12 and 13. The machine has the combination of jarring the mold, squeezing the board in place and stripping the pattern, accomplishing all these operations in a rapid and efficient way. Castings of the most exacting character can be produced on this machine.

It should be quite superfluous to remark that to get the best results the machines should be kept in good order, and that the pattern equipment should be such as to make a perfect mold.

Supplementary to the preceding we append the addresses of manufacturers of power squeezers as follows: International Molding Machine Co., Chicago, Ill.; The Berkshire Mfg. Co., Cleveland, Ohio; E. H. Mumford Co., Elizabeth, N. J.; The U. S. Molding Machine Co., Cleveland, Ohio; Federal Malleable Co., West Allis, Wis.; Henry E. Pridmore, 19th and Rockwell Sts., Chicago, Ill.; Federal Foundry Supply Co., Milwaukee, Wis.; The Tabor Mfg. Co., Philadelphia, Pa.; Davenport Machine and Foundry Co., Davenport, Iowa; Arcade Mfg. Co., Freeport, Ill.; The Osborn Mfg. Co., Cleveland, Ohio; Wm. H. Nicholls Co., 2-10 College Place, Brooklyn, N. Y.; The B. & B. Mfg. Co., Inc., Indianapolis, Ind.

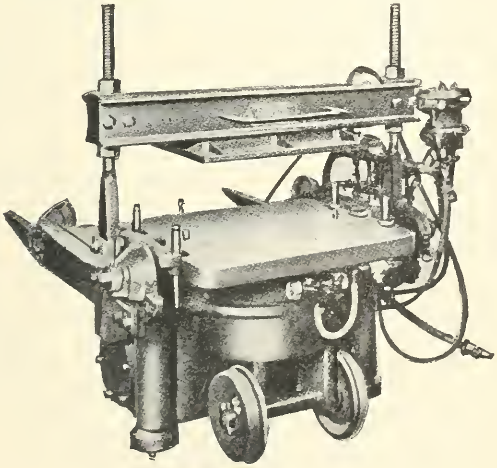


FIG. 13

SOIL AERATION AND PLANT GROWTH

Mr. A. Howard, Imperial Economic Botanist at the Agricultural Research Institute, Pusa, India, has made a study of soil aeration in agriculture, the results reached being embodied in a recent lecture. The proper aeration of the soil, in order to promote the growth of the soil bacteria which observation has shown to be necessary to the profitable production of our modern farm staples, cannot be too much insisted on.

It has often been noted that a newly dug ditch, with the earth thrown up on all sides, rarely shows any early growth of plant life on this newly thrown up earth, and this lack of growth has been attributed to the fact that the soil bacteria, so essential to plant growth, have not invaded the more deeply lying strata of the soil, and that the non-growth of plants, or at least a limited growth, on these ditch banks is attributable therefore to the non occupation by these bacteria of this newly thrown out earth.

WHEN WATER EXCLUDES THE AIR

Mr. Howard has found that a large part of the deficiency in plant growth under such circumstances may more properly be laid to the presence of water in the soil which occupies the interstices and leaves no room for the necessary aeration.

As India frequently suffers much from drought, the first outlook of the Indian agriculturist is to secure an adequate water supply for the production of crops. At the same time the water supply may readily overdo the needs of most kinds of plant life, drive out the air from the soil interstices, and leave the soil without adequate aeration for the support of plant life.

After ten years observation of the plants grown on the Indo-Gangetic alluvium, which has been closely correlated with experience at other leading points in India, Mr. Howard reaches the conclusion that a full supply of air is quite as important as a sufficiency of water. The argument is that the air is a necessary raw material for the soil organisms and for the roots of the plants wherever they may be grown. Soil ventilation is found in practice to be quite difficult on alluvial soils like those named over very large areas in the plains of India. These soils pack very readily and always run together on the surface after heavy rains, forming a well defined crust. They seem to entirely retain their porosity after long continued rains.

In an experiment made at Pusa in 1910 waterlogged soils indicated enormous losses in fertility. Waterlogged lands planted in wheat with the produce compared with that of normally drained plots, gave a yield of 16 bushels of wheat less to the acre. This was demonstrated as being largely due to denitrification following water loggings; as the increased yield obtained on a comparable stretch of land through the middle of the experimental plots when treated with 4 cwt. of nitrate of soda raised the yield in the water logged plot from 15.55 bushels of wheat to 25.17 bushels. On plots that were not water logged nitrate of soda indicated very little if any beneficial effect. It is claimed that defective aeration of the soil besides interfering with respiration of the active cells of the root and of the soil bacteria, exercises a profound influence on the development of the root system itself. The root system development of the cereals other than rice depend on aeration, and the illustration given with plants growing in jars of water shows at least a double growth of barley in a jar aerated once a day, while that aerated continuously filled the jar with roots, showing that this root development depended largely upon this aeration.

Immense quantities of linseed, or flaxseed, are produced in India and the plant is exceedingly sensitive to a wet subsoil and it wilts easily from these causes. In the experiment under consideration the subsoil at Bihar contained too much moisture and too little air, the reverse of the general conditions in the dry seasons. In such moist seasons flaxseed grown on lands subjected to the drying effects of the roots of leguminous trees does better than on ordinary land. The tree roots remove some of the excess water from the subsoil. Air then takes the place of this water and the roots act directly as aerating agents. Java indigo grown for seed often behaves in the same way. A similar state of things occurs in tea in Assam or Ceylon, where the best bushes are found on land within a radius of the action of leguminous tree roots.

Mr. Howard's conclusion is that in all such cases increased surface drainage is indicated as the best means of improving these cultures.

Some experiments with peach trees showed that the yellowing of the leaves was found to be reproduced at will either by deep planting or by over irrigation, both resulting in poor soil aeration. With improved drainage the affected trees changed into a healthy, vigorous condition in a single season and the death of certain experimental trees was pronounced to be the result of defective aeration of the soil caused by excessive surface flooding under arid conditions. About 18 million acres of the gram or chick pea crop are grown in India every year and it grows to the best advantage in well aerated soils and cannot be grown successfully under irrigation where flooding would destroy the porosity of the soil. It is found that where the soil is adapted to such culture it is porous and develops a large root system with the usual nodules for the nitrogen collecting bacteria. Java indigo cultivated in British India is a leguminous crop with root nodules. The slightest interference with the air supply of these plants makes itself manifest by leaf fall or by the shedding of the flowers without setting seed. If the air supply is partially cut off through any cause the plant loses a number of its nodules and feeding roots at once and it proceeds to adjust its leaf surface to the diminished root range. This goes on until finally death will take place, the branches wilting off in succession. The author says that wilt in indigo is the last phase of starvation of the plant.

The scarcity of synthetic indigo since the German supply has been cut off, has led to some renewed experimentation in the improvement of the indigo plant in British India. In recent years a quarter of a million dollars have been spent in indigo experimentation. It was found that the most efficient type of indigo for the Bihar conditions is to raise good seed and to see that the roots or nodules get plenty of air. The decay of the indigo industry is attributed to the gradually increasing high water level in those sections, this increase corresponding with the diminished air supply in the soil to the indigo plants. This rise in the height of the flood is attributed to the various embankments constructed in the country interfering with the free flow of the water into the great streams as was formerly the case.

As is well known in Louisiana, the rice crop can hardly be made to flourish without an adequate supply of water. It is true that by cultivation in rows or drills high land rice can be produced, but rice produced by irrigation is so much greater in quantity and thought to be better in quality that the high land rice is entirely neglected. Rice is said to be a plant that utilizes the oxzgen which is already dissolved in water and hence, fish-like as it were, it utilizes the oxygen in the water, while nearly all other industrial plants require the oxygen from the atmosphere which can only enter into the circulation of the plants through the roots and hence with sufficient soil aeration.

As collateral to these conclusions at the Bihar station reference is made to the Dutch planters of Java who have learned by long experience in the growing of sugar cane on heavy soils that there exists a close connection between the yield of sugar and soil aeration, and that the destruction of the porosity of the soil does great harm to the crop. Therefore in Java great attention is paid to the aeration of the soil on which that island and its sugar industry chiefly depend. In Java rice and sugar cane are grown alternately on the same land. Such culture demands irrigation and adequate arrangements therefor and also demands thorough drainage in order to secure aeration. Mr. Howard believes that they will have to adopt the Dutch methods in India if they expect to compete successfully with Java in sugar production. He holds that nowhere is better aeration for sugar cane so necessary as in Bihar and that the new seedling canes that are now attracting much attention in northern India cannot be developed satisfactorily unless the question of aeration receives more consideration than hitherto.

WAR EXPLOITS OF A MINING ENGINEER

One of the greatest of the exploits performed by a mining engineer was the destruction of the oil wells and stocks of oil in Roumania by Colonel Sir John Norton Griffiths. The details of this great adventure have just been published by the Roumanian Consolidated Oilfields, Limited, the largest of the English organizations interested in the Roumanian oil industry.

When Roumania declared war on the Central Powers in September, 1916, the oil industry of the country was placed in the hands of a State Commission, and production was controlled according to public requirements. By the middle of November the danger of the Roumanian armies was recognized, and it became obvious that the advance of the Germans could not be resisted. The Commission immediately devised plans to prevent the stocks of oil falling into the hands of the enemy and to prevent the wells from being operated. The proposals embodied the plugging of the wells with plugs having a secret pitch of screw and taper, the removal of a few parts of the machinery considered vital, and the withdrawal of the oil from the storage tanks and reservoirs to spots where it could be burnt without damage to tanks or buildings. The idea was to do the least permanent damage to the properties, and to trust that the invaders would be sufficiently inconvenienced thereby.

This policy was pursued in a rather dilatory and inefficient manner for a few days. On November 25 the sudden appearance of Colonel Norton Griffiths at Ploesti caused much commotion in official and commercial circles. He announced that he had been sent by the British Government to help the Roumanians to destroy the oil wells and stocks of oil, and that he had so far received no assistance from the authorities or the owners of the properties. As the matter was desperately urgent, he took a strong course, and proceeded with a plan to destroy everything absolutely. Many and stormy were the interviews between him and the Roumanian Commission.

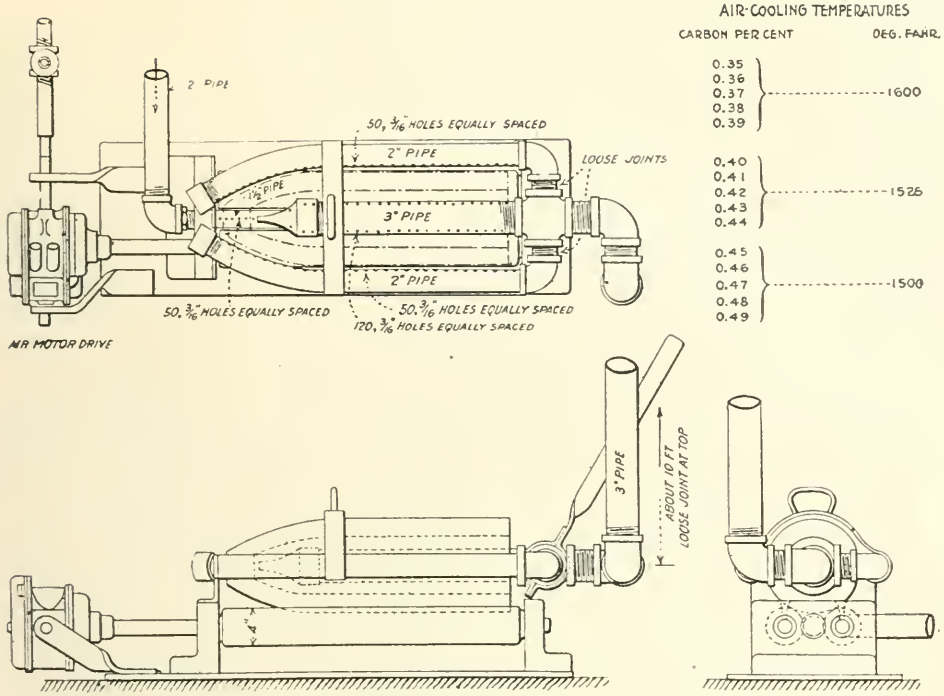
Naturally he approached the English-owned company first for support, and, after giving his word that the Allies would fully compensate the company, he enlisted the services of the chief engineers, Messrs. Thomas Masterson and J. T. Hayward, for the purpose of carrying out his plans. His difficulties were intensified by the action of the members of the Commission, who not only opposed his suggestions, but on several occasions arrested his volunteer assistants while his back was turned. Even when they eventually consented to his policy, unwillingly enough, the progress of the necessary work was so slow that he had to lead the operations personally. Iron scrap was dropped down the wells to render them unworkable; oil was let into the boilers and machinery and set on fire; sulphuric acid was poured into the plant to corrode it; and liberal use was made of sledge-hammers to break everything possible. As for the destruction of the stores of oil, some of the oil was allowed to escape from the tanks and was immediately set on fire. Within a minute the tanks, which then contained an explosive mixture of gas and air, began to explode with devastating violence. The wrecking party proceeded from one tank to another throughout the Moreni district, and destroyed over 40,000 tons of oil. The smoke from the conflagration formed a black cloud overhead which cut off the light of day, and the only illumination was that provided by the burning oil. The sparks from wooden structures set fire to the wells.

The party finally turned to the works of the Astra company, and, after firing the tanks and the shops, attempted to destroy the power-house. It was found, however, that this building was full of gas, and members of the party advised its abandonment. But Colonel Norton Griffiths was not to be beaten, and he entered the building himself with lighted straw to set fire to the oil that had been pumped into it. The space was full of gas with little or no air, so our intrepid pioneer suffered, not from an explosion, but from the effect of burns. Several days were spent in destroying wells and plant east of Moreni, and subsequently the Buzeu and Bacau fields were treated in like fashion, and here again only just in time.

COMPRESSED AIR COOLS SHELL FORGINGS

A method of air cooling 9.2-in. forgings for shells, indicated in the accompanying drawing, has been obtained from J. W. Dunphy, engineer, Canada Cement Co., Ltd., Montreal, Que., who generously contributes the information together with some comments on the performance of the apparatus. The decided success ascribed to it will make it of interest to manufacturers of shell steel.

For example: With steel having the following chemical analysis: Carbon, 0.42 per cent.; silicon, 0.063 per cent.; sulphur, 0.034; phosphorus, 0.025; manganese, 0.48, the physical results after proper heat treatment and cooling under ordinary atmospheric conditions gave a yield point of 40,300 lb. per sq. in., a tensile strength of 80,600 and an elongation of 27 per cent. The results with cooling with the apparatus shown gave a yield point


2 PIPE
50, 3/16 HOLES EQUALLY SPACED
2" PIPE
1½ PIPE
3" PIPE
LOOSE JOINTS
2" PIPE
50, 3/16 HOLES EQUALLY SPACED
50, 3/16 HOLES EQUALLY SPACED
120, 3/16 HOLES EQUALLY SPACED
AIR MOTOR DRIVE
3" PIPE
ABOUT 10 FT
LOOSE JOINT AT TOP
4"

AIR-COOLING TEMPERATURES

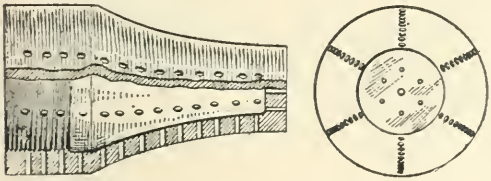
CARBON PER CENT	DEG. FAHR.
0.35 0.36 0.37 0.38 0.39	1600
0.40 0.41 0.42 0.43 0.44	1526
0.45 0.46 0.47 0.48 0.49	1500

AIR-COOLING SHELL FORGINGS

of 49,300 lb.; a tensile strength of 94,000 lb. and an elongation of 25 per cent.

The air consumption is 2100 cu. ft. per min. and it takes approximately 5 min. to cool the forging from the temperature on coming from the furnace to 800 deg. Fahr. The air is supplied at 80 lb. per sq. in. The drawing indicates how the air pipes are lifted and swung away to remove the one and place in position the next forging. A compressed air motor is employed to rotate one of two rollers on which the forging is supported, the other acting as an idler so that the forging is rotated while cooling.

One of the illustrations shows the special nozzle on the end of the internal air pipe. This serves as a centering device and is drilled as indicated to cool the nose of the forging.—*Iron Age.*



COOLING AND CENTERING NOZZLE

PNEUMATIC TOOLS IN SHIPYARDS

BY GLENN B. HARRIS

Perhaps in no other branch of the metal industry have pneumatic tools proven of greater value than in the shipyards of the country engaged in the building of steel ships.

The chipping hammer has proven of incalculable benefit in all chipping operations, and of equal value in calking. In the latter operation it is, of course, used on all side and deck seams as well as on bulkheads and tanks, and its gain over hand work is probably three to one, while the character of the work performed by it is superior to that done by hand, inasmuch as the blow delivered by the pneumatic hammer, is always of uniform character, due to a practically constant air pressure, while it is said that the work of a man by hand is not so marked, owing probably to the fact that he is fresh and vigorous in the morning and wanes in strength as the day progresses. Calking done by machine, even when tested by high pressure, seldom shows a "sweat." In the boiler shops of shipyards the pneumatic tool is used also with the same advantage.

In chipping, the pneumatic hammer is used for all operations of that character, and, as is well known, there are many of the tools required in ship construction.

They are utilized to cut and finish up patch bolts on the eye of a propeller, in making up patch plates on boss and propeller eye, in cutting out hawse holes, and other work for which the hand hammer has been ordinarily employed. The chipping hammer unquestionably does the work of at least three hand workers.

In an amplified form the pneumatic hammer has proven also to be of the greatest benefit to the ship building industry. Reference in this connection is here made to the riveting hammer.

THE RIVETING HAMMER

This is simply the chipping and calking hammer in enlarged size. The piston diameter is not materially increased, but the length of stroke is extended from that of the chipping hammer, which is about 2 or 3 in., to 6 in., 8 in. or 9 in.

The hammer as originally introduced for shipyard work was mounted in various devices for ship riveting. There was a special machine for driving flush deck rivets, which consisted of a heavy, cumbersome frame carrying a pneumatic hammer of extraordinary proportions. This machine did the deck riveting, and a man with a chipping hammer cut off the head, after which in some instances the rivet was driven further into place, although unnecessary, except, perhaps, for the purpose of smoothing down. This was an absolutely unnecessary proposition, as the ordinary pneumatic hand hammer would do the work with greater efficiency and in less time.

In the case of outside or shell riveting an apparatus was provided for holding the riveting hammer. This has since been dispensed with and the usual type of riveting hammer employed to take its place.

The riveting hammer has worked a revolution in the construction of steel ships, not only permitting their construction in a short period of time, but lessening materially the cost of production.

An ingenious device which is a modification of the pneumatic hammer is utilized for packing condenser tubes. A leaky condenser on board ship causes a great deal of trouble and it is claimed that the cause of leakage in a great many instances can be directly traced to the fact that the packing laces are not carefully laid in. Twelve to eighteen tube ends can be packed per minute, and experts have exceeded this number in the same length of time. As with the calking and chipping hammer the work of the packing tool is of a uniform character, and each tube is packed precisely like its neighbor. The machine is light and easily handled, and is undoubtedly of value for the purpose for which it was designed.

THE PNEUMATIC DRILL

The air drill is of equally great saving in the shipyard, as is the pneumatic hammer, and the uses to which it is put are varied and numerous. In addition to all drilling operations requisite in ship construction, this conveniently portable machine is used to greater advantage in reaming operations, for boring in wood and different grinding operations. What is known as a close corner drill is also marketed and is of particular use and has been almost universally adopted in shipbuilding for rolling the outer tier of flues in boilers; also for tapping and other work in close quarters. The pneumatic drill is also used to great advantage in drilling out rivets in the shells of ships. Various new uses are continually suggesting themselves for the employment of this tool, and they all make for economy in production.

PROPER HANDLING OF PNEUMATIC TOOLS

In most yards the workmen handling pneumatic tools are not mechanics, and the machines require careful handling to obtain the best results. This is hardly to be expected of unskilled labor. Like all other classes of machinery, these devices must receive proper lubrication to insure the best results, and this, with their proper cleaning, is most essential.

The writer, from a long experience in this line, knows full well that the material used in all these tools is the best obtainable. There have been long periods of experiment to get what will stand the wear and tear to which they are subjected. The moving parts in both the hammers and drills are accurately and closely fitted, and when proper lubrication is neglected these fine pieces of machinery wear rapidly and in a very short time refuse to work.

As the air which is taken into the compressor generally contains some particles of grit and dust, the working parts of the hammer and drill are likely to become clogged with this foreign matter, causing the ports to become closed and the tools rendered inoperative. The use of a poor grade or heavy-bodied oil will also cause the same trouble. The best plan to follow in a case of this kind is to cleanse by introducing gasoline (petrol) in the air induction. This will dislodge any extraneous matter and cuts the thick oil, both of which can then be removed by blowing air through the hammer.

BLOW OUT PIPES AND HOSE

Another great source of trouble and annoyance is sometimes located in the pipe line. Moisture in the air will rust the pipes through which it is conveyed, and if the tools are connected up without first blowing out the pipes a sediment is likely to be blown through into the tool, causing valves or pistons to stick. Rubber deteriorates rapidly and dislodged particles may blow through into the tool and render it inoperative.

It frequently occurs that a workman will make complaint that his hammer or drill is not working properly, or that it will not run at all. In a great many of these cases, on the machine going to the tool room, it is found that sediment or pieces of rubber were at the bottom of all the trouble, and when cleaned with gasoline (petrol) and oiled they would work perfectly.

In a great many of the plants of this country a special tank is provided, in which the tools are immersed at night, then blown out in the morning and thoroughly oiled with the best grade of light machinery oil obtainable. This will not only greatly prolong the life of the tool, but much superior results will be obtained in all ways. It is also a wise plan to make use of a strainer at the induction end of the tool. It is remarkable what an accumulation of grit and dirt will be gathered in a short space of time under the usual conditions in a shipyard.

HARMFULNESS OF SHORT PISTONS

One of the most flagrant abuses to which the pneumatic riveting hammer is subjected is the use of short pistons. The riveting hammer was designed with all its parts properly proportioned to meet the requirements of various classes of work for which these tools are adapted. The workmen have discovered, however, that a piston reduced from the standard of 4 inches in length to 2½ inches delivers a more rapid blow and for a time performs faster work and with greater ease of holding. Short pistons, however, not having the body of metal in them, are subject to crumbling, due to the hard work to which they are subjected. The small, broken parts cut the cylinder, and if the latter is not damaged beyond repair from this cause it is only a question of a short time before the hammer is irreparably ruined.

When cylinders are cracked and handles and rivet sets broken the hammer should be examined to determine whether the workmen have in service a short piston. They have devious ways of obtaining them. The only sure way to determine whether a short piston has been substituted for the proper one is to have them examined while in service, as it has been found that the workmen carry the short pistons with them, make an exchange after taking the hammer out of the tool room and then replace the proper piston at the end of the day, when the tool is returned to its proper quarters.

Another abuse of pneumatic tools is the taking of them apart and the putting of them together again. Some repairmen, instead of using a wrench or soft hammer in loosening or tightening the handle of a riveting or chipping hammer, will employ a hard hammer, badly battering the parts and sometimes breaking them. The finished parts should never be struck with anything but a lead or copper hammer, and even when this is done care should be used not to unnecessarily strain the threads between the cylinder and handle.

It will pay any shipbuilding plant to employ a man who is competent to look after the penumatic tools and see that they are properly cleaned and lubricated. In cold weather it is a wise proposition to warm up the tool. This can be done at the rivet forge. With the blow of the piston in the riveting hammer on the set when the parts are cold breakage is likely to occur. In some yards with which the writer is acquainted it is a practice to offer a premium to the workman taking good care of his tool. This should result in a saving to users of pneumatic appliances of all kinds.—*Marine Engineering.*

GASIFYING CRUDE OIL FOR SPRAY BURNERS

BY W. A. JANSSEN*

The first spray nozzle for burning oil was developed in America. Since then there have been innumerable modifications of spray and jet burners. These may be divided into two classes, high pressure and low pressure types. Aside from the pressure of operation, they also vary in design and construction, depending upon the atomizing agent used. These burners are dependent for their success on the use of air or steam as an atomizing agent. In addition some burners also have incorporated in their construction some form of spiral for mechanical atomization.

The spray burner consists essentially of a fan-shaped spray of steam or compressed air upon which a stream of oil is allowed to trickle, the oil being diffused or atomized and burned. The jet burners, of which there are many types, are so constructed that a stream of oil is swept into and becomes a part of a stream of air of steam, being atomized therein and subsequently burned. The spray and jet types of burners have their limitations, because of their inability to maintain a positive adjustment of the definite amounts of oil and air necessary to assure and produce perfect combustion. This condition is further aggravated by the use of oils of variable specific gravity, which congeal in cold weather, making perfect combustion almost impossible without the almost constant attention of the furnace operator.

Because of the inability to properly control the air supply to definite combustion proportions, the quantity of air is usually in excess of theoretical requirements for complete combustion, causing a reduced flame temperature. In the spray and jet types of burners, it is essential that there be an abundance of air in order to assure complete atomization and avoid smoking. If the burners are adjusted so as to admit a theoretical amount of air, the oil is not thoroughly atomized, resulting in imperfect combustion, accompanied by excessive smoking and attendant reduction in flame and furnace temperature. The great objection to the present methods of oil burning is because the vaporization and combustion are practically simultaneous and that both occur within the combustion chamber.

NEW SYSTEM OF GASIFYING

During the past year there has been developed a system of oil burning wherein the oil, instead of being atomized or vaporized, is gasified in a specially designed vaporizer outside of the furnace. The gaseous product is forced into a combustion chamber under positive pressure, resulting in perfect combustion. This method of oil burning consists essentially of producing an oil-gas in a specially constructed vaporizer outside of the furnace proper, through the union of oil and heated air in definite proportions for perfect combustion. The air for combustion is delivered by a compressor at about 2-lb. pressure and a velocity of 150 ft. per sec. The air is forced to the vaporizer through cast-iron preheater boxes placed in the path of the outgoing waste gases. With the admixture of oil in the vaporizer, a gaseous product is formed which is delivered to the combustion chamber under continuous pressure.

The cast-iron preheater, Fig. 1, consists of a closed cast-iron box with openings to connecting boxes for the admission of incoming air. A series of vertical flues are provided to permit the passage of the outgoing waste gases through the apparatus, thus providing a source of heat for preheating the air for combustion. The number of preheaters required is dependent on the oil consumption for which the furnace is designed. They are stacked one over the other, and are so placed in the path of the outgoing gases that their walls will transmit the maximum amount of heat. Each heater is provided with an inlet and outlet opening for the admission of air. They are located on the opposite ends of the heater, necessitating a complete passage of air through the apparatus. As the heaters are stacked, the inlet opening of one connects with the outlet opening of another. With this arrangement the vertical flues are thrown out of line, thereby retarding the flow of the outgoing gases, permitting a greater heat absorption through the walls of the preheaters.

THE VAPORIZER

The vaporizer, Fig. 2, is a hollow cast-iron fitting. Its size is dependent on the calculated oil consumption. It has conveniently arranged inlet and outlet openings. Within the vapor-

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*From a paper at the annual meeting of the American Foundrymen's Association, Boston, Sept. 27, 1917.

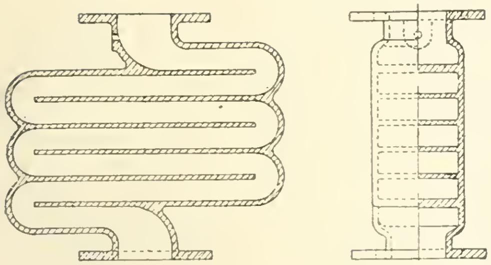

FIG. 1

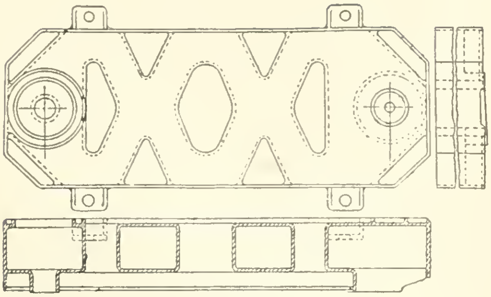

FIG. 2

izer are a series of baffles which form a winding zigzag path for the gaseous mixture of air and oil. The long winding passage is essential for complete gasification. The preheated air enters the inlet of the vaporizer and commingles with the oil stream. On striking the first baffle, gasification is begun. The mixture of air and oil gas then winds past the succeeding baffles. It finally is discharged from the vaporizer through a pipe in the furnace wall leading to the combustion chamber.

If perfect combustion is to be attained, the proportions of oil and air must be right and the temperature of the preheated air also must be correct. The installation operates most efficiently when the temperature of the air is about 800 deg. Fahr. Allowing a temperature drop of about 100 deg. for radiation and the conversion of oil to gas, the net temperature of the gaseous mixture is about 700 deg. Fahr. The velocity of the gaseous mixture should be about 150 ft. per sec. in order to prevent back-firing or flame propagation in the direction of the source. This is most essential, as the temperature of ignition, 1,050 deg. Fahr., is only a few hundred degrees higher than the temperature of the gaseous mixture, which in the proximity of the heated combustion chamber almost instantly is brought to ignition temperature.

The heavy fuel oils of commerce are practically all of the following composition: Carbon, 84.9 per cent.; hydrogen, 13.7 per cent., and oxygen, 1.4 per cent. The Baume gravity is 26 deg. and the oil weighs 7.4 lb. per gallon. For perfect combustion this necessitates about 3.4 lb. of oxygen or 14.5 lb. of air per pound of oil. This is equivalent to 180 ft. of free air per pound of oil, or about 1,500 cu. ft. of free air per gallon. This may be more easily expressed as 25 cu. ft. per minute per gallon per hour.

WAR STATUS OF EXPLOSIVES

Any person in the United States found with explosives in his possession after November 15, and who does not have a license issued by the Federal government showing the purpose for which the explosives are to be used, will be at once arrested and fined up to $5,000 or sent to prison for one year. If the circumstances warrant, the person may be fined $5,000 and in addition given the one year in prison.

This is the principal clause in a war measure passed by the last Congress and which is now being put into effect by the Bureau of Mines, Department of the Interior, which bureau has been charged with its enforcement. Francis S. Peabody, of Chicago, a well known coal operator familiar with the use of explosives, has been appointed by Secretary of the Interior Lane to act as assistant to the Director of the Bureau of Mines, Van H. Manning, in the enforcement of the law. Under the law, the Director of the bureau is empowered to utilize the services of all United States officers and all police officers of the states. The police of the cities have already been organized for this work, headed by a committee of chiefs of police in the big cities, of which Major R. W. Pullman, superintendent of police of Washington, D. C., is chairman. The police are not only to look after the enforcement of the law, but are also to make thorough investigations of all dynamite outrages and fires in factories and warehouses, and to make their reports to the Director of the Bureau of Mines.

Persons apprehended in plots to blow up factories and bridges will be turned over to the authorities for prosecution under Federal or state laws. Most states have specially severe punishments for these crimes. New York has an extreme penalty of twenty-five years imprisonment for the placing of dynamite with intent to blow up property. The penalty provided in this Federal war measure is merely to cover the illegal possession of explosives.

The law provides that everyone who handles explosives must have a license. The manufacturer, the importer and the exporter must have licenses issued by the Bureau of Mines in Washington. The seller of explosives and the purchaser of explosives must also have licenses, these to be issued generally by county clerks, or other local officers who are authorized to administer oaths. There will be at least one licensing officer in each county, and more agents will be designated if the county is sufficiently large to warrant it. If a state has laws providing for a system of licensing persons manufacturing, storing, selling or using explosives, the state officials authorized to issue such state licenses shall be designated as federal licensing agents; also city officials qualified to issue city explosives licenses will be given authority to issue federal licenses. A federal license will not relieves any person from securing licenses required under state laws and local ordinances.

In each state there will be appointed a state explosives inspector, who will represent the Bureau of Mines in the administration of the law within the state.

Only citizens of the United States or of countries friendly to the United States and the Allies may so obtain licenses.

Contractors, mining companies, quarrymen and others using large quantities of explosives, which are handled by employees, may issue explosives to their employees only through those employees holding a license, called a foreman's license.

The purchaser of dynamite, in obtaining a license, must state definitely what the explosive is to be used for and will be held accountable for its use as stated and the return of any explosives that may be left.

With the strict enforcement of this law, the Federal authorities hope to prevent explosives falling into the hands of evilly-disposed persons and to put a stop to all further dynamite plots.

YOUR DEAR LAD AND MY DEAR LAD

Down toward the deep blue water, marching to the throb of drum,
From city street and country lane the lines of khaki come;
The rumbling guns, the sturdy tread, are full of grim appeal,
While rays of western sunshine flash back from burnished steel;
With eager eyes and cheeks aflame the serried ranks advance;
And your dear lad, and my dear lad, are on their way to France.

A sob clings choking in the throat, as rank on rank sweeps by,
Between those cheering multitudes, to where the great ships lie;
The batteries halt, the columns wheel, to clear-toned bugle call,
With shoulders squared and faces front they stand a khaki wall.
Tears shine on every watcher's cheeks, love speaks in every glance;
For your dear lad, and my dear lad, are on their way to France.

Before them, through a mist of years, in soldier buff or blue,
Brave comrades from a thousand fields watch now in proud review;
The same old Flag, the same old Faith—the Freedom of the World—
Spells Duty in those flapping folds above long ranks unfurled.
Strong are the hearts which bear along Democracy's advance,
As your dear lad, and my dear lad, go on their way to France.

The word rings outs; a million feet tramp forward on the road,
Along that path of sacrifice o'er which their fathers strode,
With eager eyes and cheeks aflame, with cheers on smiling lips,
These fighting men of '17 move onward to their ships.
Nor even love may hold them back, or halt that stern advance,
As your dear lad, and my dear lad, go on their way to France.

—*Randall Parrish, in Chicago Tribune.*

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We have been given the opportunity to serve mankind as we once served ourselves in the great day of our Declaration of Independence, by taking up arms against a tyranny that threatened to master and debase men everywhere and joining with other free peoples in demanding for all the nations of the world what we then demanded and obtained for ourselves. In this day of the revelation of our duty not only to defend our own rights as a nation but to defend also the rights of free men throughout the world, there has been vouchsafed us in full and inspiring measure the resolution and spirit of united action. We have been brought to one mind and purpose. A new vigor of common counsel and common action has been revealed in us. We should especially thank God that in such circumstances, in the midst of the greatest enterprise the spirits of men have ever entered upon, we have, if we but observe a reasonable and practicable economy, abundance with which to supply the needs of those associated with us as well as our own. A new light shines about us. The great duties of a new day awaken a new and greater national spirit in us. We shall never again be divided or wonder what stuff we are made of.—*WOODROW WILSON.*

JOHN D. CRIMMINS

John D. Crimmins died at his home in New York City Nov. 9, not far from the location where he was born nearly seventy-four years ago. All his life he was supereminently a New Yorker, our space limits prohibiting any attempt even to enumerate his specific activities. He was one of the great builders of the modern metropolis. He was the first contractor to employ commercially the rock drill in a large way in other than tunnel work. He planned and completed for the city large and difficult poritons of the "New" Croton Aqueduct, made the excavations for the gas tanks of many companies, built a large part of the first elevated railway, laid the Broadway cable road, built many large hospitals, churches, schools and business structures. At times he had in his direct employ over 12,000 men and many more indirectly in sub-contracts.

John D. Crimmins was a many sided man, largely helpful in all the human activities of the city, political, religious, educational, reformative and beneficent. He was an ardent lover of everything beautiful in nature and art, and possessed a large collection of artistic and literary treasures. His success was well won, and all may be thankful that it was so.

EUGENE FRANZ ROEBER

The death of Doctor Roeber, the upbuilder and the one editor from the beginning of the admirable *Metallurgical and Chemical Engineering*, is a loss of unusual magnitude, not only to the publication of which he had made a stable success, but to the technical and scientific world and to the circle who had personally learned to love him as a true and ever helpful friend and to appreciate and admire him as a man. Just fifty years of age, perfectly equipped for his life work and in the full maturity of his powers, a score of years of productive usefulness might have been expected of him, but this was not to be realized. We know that our readers will appreciate and will thank us for the reproduction of the following heart-felt tribute of loyal appreciation from the editorial page of the journal which had so largely and so long embodied his personality.

A quiet funeral in a little house in East Orange, the body of its gentle master at rest among flowers in the parlor, the conventional service of death and the benediction—and the leaf of the big book was turned. Just a few words in ecclesiastical monotone—and everything so different. The machinery mumbles on, the presses revolve, the paper is whisked back and forth in the manner appointed, everything proceeds as before, but somehow the heart of it is still, and all the rest of us, major and minor parts of the organization, are benumbed for the time. We are catching our breath for a fresh start. Of course, the paper will continue; it will look the same and serve the same purpose, because it was planned unto whatever merit it has by one who had a great gift for this very thing.

Now let us consider what manner of man this was, who infused so strong a personality into his editorial work that the paper was almost as frequently spoken of as "Roeber's Journal" as by its printed title. Although he occupied posts of distinction, had been president of the American Electrochemical Society, of which he was one of the founders, and associated with many men of high repute on important committees, his acquaintance among men was far slighter than his influence over them. This was in part because his influence was widespread and in part because of his unusual modesty and extraordinary sensitiveness, which he had in greater measure than was compatible with comfort.

He was a little, round man with a round chin, round spectacles and a big round hat designed for a Texas sombrero, but which on his head straightway became *ein Professorenhut.* He was German born—anybody could see that—but he was the kind that those of us who knew Germany best before the war still love despite everything. And he was a thoroughly sound, patriotic, loyal American citizen without any reservation. He believed in everybody, had faith in everybody and a good word for everybody. There was such kindliness and goodwill in his greeting, in his unflinching, believing, encouraging look that the very thought that those gentle blue eyes are dimmed for all time bites into the heart.

The man on the street or in the railway car did not know these things, and so sometimes he was taken for an enemy alien—our editor —whose father and grandfather had opposed Prussianism all their lives and who himself had left Germany because of it. But the slightest unfriendly glance, or the tone of a word spoken in scorn were enough to give him acute pain. Rarely have we known a mortal with such hair-trigger sensitiveness. Nevertheless, he would not let it hinder him from digging into the day's work or from bearing the sting of it in silence. We verily believe that this shortened his life.

In his office, at his desk, he was a different man. There command was easy to him and there was no hesitation in his decisions. When well-wishers urged him to avoid printing articles with mathematical developments beyond the reach of most readers, he would smile, shake his head—and print in full. If a fair word about labor might offend someone who had neglected to provide for the life, liberty and pursuit of happiness of employees, he would chuckle—and print it. Neither conventional ethics nor philosophy frightened him. He edited a technical paper, but he never forgot the human factor in applied science and industry. When he felt that something needed to be said, he had no interest in minor consequences. He had confidence in his own wisdom, and Wisdom herself was justified in him. He was gracious in receiving advice, but independent in his conclusions. To think or to decide—and decide aright—was neither hard nor painful to him. He was a master at his profession and he breathed the breath of life into his work.

In taking up the burden that has fallen from his shoulders, the editors and publishers are not concerned about articles, or their arrangement, or about comment on things of interest, or advertisements, for these are all provided for. The burden of our hope is that we may attain the same at-homeness in the work and the same cordial goodwill of our readers that the late Dr. Roeber both won and enjoyed. Peace to his memory.

NEW BOOKS

The Commonwealth of Pennsylvania, by Thomas Kilby Smith. The Encyclopedia Press, Inc., New York. 328 pages, 5 by 7½ in., 6 full page half tones and map, $1.00.

This is the first of a projected series of hand-books of the different States of the Union. It is a concise history and much more than that, not only relating the story of the events but setting forth the conditions, institutions and agencies which make the background and furnish the environment for their presentation. The various things for which the State has been notable and the lofty status of the Commonwealth today are ably presented.

The Principles of Iron Founding, by Richard Moldenke, E. M., Ph. D., McGraw-Hill Book Company, New York, 527 pages, 6 by 9 inches, 45 cuts in the text, $4.00 net.

This book, by the Nestor of American foundrymen, must at once take its place as a standard work, a position which it may be expected to deservedly hold for long years to come. The field of iron founding, in its largest sense, is completely covered. As it says: "it goes into the elements of iron making, with its allied industries, with the object of drawing conclusions therefor of value to the foundryman in his daily work." It has nothing whatever to do with the details of the molder's art. It is a rather curious thing that while the use of iron can be traced back some four thousand years, cast-iron is quite a modern product, and what this work calls "the modern foundry advance practically all fell within the last twenty years of the nineteenth century," so that the present book could not well have been prepared at any earlier date.

THE EXPLOSIVES LAW

For the administration of the Explosives Law, approved October 6, the Bureau of Mines is appointing licensing agents in all parts of the country, and is sending to them the necessary application blanks, license forms, etc., and publicity matter which will appear in local papers, outlining the procedure necessary to secure licenses.

As fast as licensors are designated and notice given in this way to the public, licenses will be issued in all localities. Meanwhile "business as usual" is urged, to the end that there may be no interruption in production of coal or other necessities involving the use of explosives.

On and after November 15, all manufacturers, vendors, foremen, exporters, importers, and analysts who deal with explosives or ingredients of explosives shall keep an itemized record of sales, issues, or other disposition made of explosives and ingredients, pending receipt of detailed instructions and the securing of necessary licenses required by law.

THE LIBERTY MOTOR FROM DIFFERENT VIEWPOINTS

One of the first problems which confronted the War Department and the Aircraft Production Board after the declaration of hostilities was to produce quickly a dependable aviation motor. Two courses were open. One was to encourage manufacturers to develop their own types; the other to bring the best of all types together and develop them. The necessity for speed and quantity production resulted in the choice of the latter course. By the inspiring co-operation of consulting engineers and motor manufacturers, who gave up trade secrets under the emergency of war needs, a new motor, designated by the Signal Service as the "liberty motor," has been developed for the use of the United States air service, and is the country's main reliance for the rapid production of this important component of high-powered battle planes.

In power, speed, service, ability, and minimum weight the new engine invites comparison with the best the European war has produced. One of the chief rules adopted at the beginning of the designing work was that no engineer should be permitted to introduce construction which had not been tried out: there was no time for theorizing. The new engine is successful because it embodies the best thought of engineering experience to date. Not only did consulting engineers of this country furnish ideas, but representatives in the United States of England, France, and Italy contributed to the development of this motor.

While it is not deemed expedient to set forth in detail the satisfactory performances and the mechanics of the new motor, it may be said that standardization is a chief factor in the development of the Government's motor. Cylinders, pistons, and every other part have been standardized. They may be produced rapidly and economically by a great many factories operating under Government contracts, and may be rapidly assembled, either by these plants or at a central assembly plant. It should be understood that the "new" motor is not, strictly speaking, an invention. No doubt it has what are in effect new values, but the real result achieved is the combination of the strong points of all the available contrivances of the kind.—*Aerial Age.*

In a recent number of the *Official Bulletin* of the United States, the story of America's effort to develop in a few days an aeroplane engine which would "lick creation," is told with a journalistic touch that is quite unofficial. Those who are interested, and who is not, may read it on another page of this issue. They will observe that American engineering pride had been stung to the quick by the statements freely circulated a few months ago, that if the United States were to be in a position to produce the huge fleet of aeroplanes, for the construction of which one hundred and twenty million pounds had been voted, they would have to adopt European models. Rather than submit to such a slight upon its skill, America resolved to set about the design of an engine in record time——before ever the models could cross the Atlantic. This was something after the American heart—a real "stunt." The authorities, equivalent to our Air Board, "figuratively locked" two designers in a suite of rooms in a Washington hotel for five days. Consulting engineers and draughtsmen from various sections of the country came to help them, the drawings of all aero-engines that had ever been were collected around them, and every manufacturer in the country threw his knowledge and experience at their feet. It must all have been a bit embarrassing, but our cousins work best under a degree of bustle that would upset us at home. The great work began on June 3rd, and exactly one calendar month later the new engine was set up. But to complete the "stunt," it had to be run in the "nation's capital" on Independence Day, and four young men transported it in a special express car from the Western city where it was built to Washington. Thirty days later, the Government felt justified in accepting the engine as "the best produced in any country," and American engineering pride was re-established. We do not do things in quite such a dramatic way in the old country, we like less limelight, but we are not the less ready to admit the greatness of the achievement. The engine is, no doubt, a composite of all types, but it is perfectly standardised, and manufacturers are already busy turning out the parts by the thousand. We may opine that it is very American, as American as Ford or Overland cars, and that it is made in a way that would rather shock our engineering susceptibilities. British and French machines, says the *Official Bulletin,* are "not adapted to American manufacturing methods. . . . It would require a year or more to teach American manufacturers and their mechanics to turn out such high-specialised aeroplanes." That gives a clue to the type, and makes us impatient to see an engine which, whatever its lack of qualities on which, here, we set our hearts, is an economical proposition, because it is "good enough" and not "too good," as so many of our munitions of war are. The real measure of excellence is successful operation —nothing else matters when one is in a hurry. —*The Engineer, London.*

NOTES

An empty 12-in. cast iron water main 760 ft. long was nearly buoyant enough to float when the ends were tightly closed, and was easily handled in the Monongahela River, at McKeesport, Pa. The sections were continuously jointed together on shore, launched, and supported at intervals of 100 to 150 ft. by suspension from barges, until the whole line was completed, towed to position and lowered to the dredged trench. The whole operation including the dredging of the trench was accomplished by 15 or 20 men in 15 days.

There might be serious objection on the part of a food commissioner and on the part of temperance people in the exportation of millions of gallons of molasses from Porto Rico to Martinique to be used in the manufacture of rum, but this rum is being sent to France to be used against the Germans, for it appears in No Man's Land as high explosive.

A large Louisiana fishing company has cut down its fuel bill more than $300 a month by installing in an oyster boat a gas-producer plant which transforms coal into power gas. This gas is being burned in an explosive engine instead of gasoline.

Driving a Diesel engine with gas made from peat is one of the developments of the coal and oil shortage in Denmark, says *Commerce Reports*. A large engine shop in Copenhagen announces this new adaptation.

The Liberty Loan Oil Co. has been incorporated under the Colorado laws with a capitalization of $250,000 divided into five million shares of a par-value of five cents.

American railroads have achieved the feat of adding to their freight service, in the short space of two years, an amount equal to the total traffic of Great Britain, France, Russia, Germany, and Austria combined.

Consumption of black blasting powder in the United States in 1916 amounted to over 8,600,000 kegs of 25 lb. each. Of this amount, metal and coal mining consumed 7,392,000 kegs, the remainder being used in other operations.

One of the innovations adaptable to the use of sand belts, is the pneumatic pulley to be used in place of the padded wheel. This pulley is inflated in much the same manner as a bicycle tire, and its convenience and practicability lie in the fact that it can be inflated very hard, to offer a small surface of the belt to the work, or if desired to adapt it to a flatter surface, less air pressure is given.

The Louisiana sugar industry will have $5,000,000 worth of blackstrap molasses this year as residue from sugar making. Formerly such molasses was distilled into whiskey, but this year it will be turned into commercial alcohol for munition purposes, and also sold for mixing in cattle feed.

What is probably the world's highest velocity rope drive, according to J. Melville Alison, is in operation in Cleveland, Ohio, where 19 two-inch ropes travel 7,800 ft. (1.47 miles) per min. over a driving sheave 14 ft. 4 in. diameter to a driven sheave 4 ft. 7 in., only 27½ rope-diameters, transmitting about 1,400 hp.

New drill steel used during 1916 by the Old Dominion Copper Mining and Smelting Co., Gloebe, Ariz., according to the "Old Dominion Bulletin" consisted of 1.5 tons Bull Moose, 8 tons stoper, 2.5 tons plugger and 3.5 tons Leyner. One man sharpens and one man tempers all steel, averaging 455 pieces per day each during 1916.

The British government has decided that the construction of the proposed tunnel under the British channel is not to be proceeded with until after the war. The tunnel could not be completed so as to be of any particular assistance during the war. Had such a tunnel been ready at the beginning of the war, however, it might have been of considerable value.

As a general rule, it may be stated that in case of a mine explosion when men are working underground, arbitrary reversing of the air current in a mine ventilated by an exhaust fan is not wise, especially when the main traveling roads are on the intake current. Many men have lost their lives through air reversal when they were on their way out of the mine after an accident.

The power from a gallon of gasoline is generally rated in these days by the distance it will propel an automobile. But the same energy, if directed to other and more varied purposes, will milk three hundred cows, bale four tons of hay, mix thirty-five cubic yards of cement, plow three-fifths of an acre of ground, or it will generate enough electricity to light a large farmhouse for thirty hours."

Advocates of all-welded piping systems will be pleased to know that a brewery having a very extensive suction-gas (ammonia) piping system, has just completed remodeling the system, welding the whole to do away with joints. Oxyacetylene was the process used. The progress in this field generally is indicative that the days of flanged headers, receivers, manifolds, etc., as well as piping systems with numerous flanged joints, are soon to pass away.

According to statements made by merchant captains arriving at ports in the United States the periscopes of German submarines are now being nickel plated or bronzed with aluminum in order to make them invisible. This process, it is claimed, reflects the colors of the surrounding water and leaves the periscope indistinguishable from the water. The officers said the fact that so many steamships of late have been sunk without anyone aboard having seen any sign of a submarine is proof of the truth that the U-boat periscopes have been rendered "invisible."

The production of stainless steel cutlery is one of Sheffield's great achievements of the last year or two. At the present time its manufacture is greatly restricted or entirely suspended owing to the war requirements in connection with chrome steel. The steel is the invention of Mr. Harry Brearley, and it contains 12 to 14% of chromium and 0·25 to 0·35% carbon. Unlike many types of stainless metal knives, it gives an excellent cutting edge. Knives in constant use at the table for months withstand the ravages of even mustard pickles, the most corrosive of foods or condiments. They remain perfectly bright, and require nothing but a damp cloth for cleaning.

An irrigation project that will supply 50,000,000 gal. of water daily is now under construction on the island of Maui, Hawaiian Islands, by the Pioneer Plantation. The main part of the project is a tunnel 1½ miles long, cutting across five ridges and replacing several miles of metal flume. The water is also to be used for the development of electric power. The project includes the replacement of 1½ miles of metal flume by a concrete-lined ditch, and the construction of concrete bridges over the main ditches in place of wooden structures.

A training school for women oxy-acetylene welders has been established at Notting Hill Gate in England, the expenses in connection with which are paid by the British Government. About two hundred skilled women welders have been trained in this school and at least twenty women are constantly in training. The trained women are successfully carrying out welding work in airplane factories, and the demand for them is so great that so far all the welders have been engaged by the various factories two or three weeks ahead of the completion of their course of instruction.

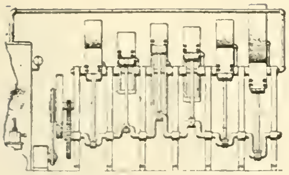
New York City's garbage, by treatment in a $3,000,000 recovery plant of the latest type on Staten Island, yields the following commercial products: Grease for 70,000,000 cakes of soap; 1,500 tons of nitrogen; 2,000 tons of phosphoric acid; 500 tons of potash. With the nitrogen, and the glycerin from soap making, there is a recovery of material yielding 3,500,000 pounds of high explosives, while the phosphoric acid and potash, as well as the nitrogen, are valuable in the making of commercial fertilizers. This plant operating under the so-called Cobwell process, which treats garbage almost entirely by chemical methods, has effected increased recoveries of valuable products amounting to at least 25 per cent. more than recoveries under the best previous reduction methods used for New York's garbage. In soap, for instance, there is an additional recovery of grease for 10,000,000 cakes a year, and in high explosives material for 700,000 pounds.

LATEST U. S. PATENTS

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

OCTOBER 2.

1,241,524. HUMIDIFYING DEVICE. Victor A. Larson, Chicago, Ill.
1,241,545. AERIAL TORPEDO. Frank H. Patton, Flagstaff, Ariz.
1,241,581-2. FLUID-PRESSURE BRAKE APPARATUS. Walter V. Turner, Edgewood, Pa.
1,241-711. MOVEMENT-CONTROLLING MECHANISM FOR POWER-DRIVEN VEHICLES. James Culton, Denver, Colo.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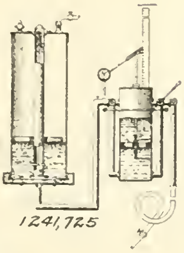
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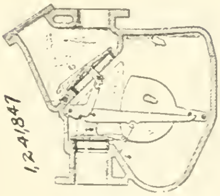
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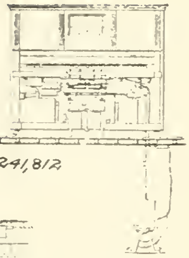
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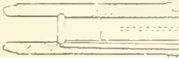
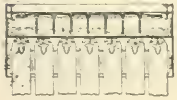

1,241,962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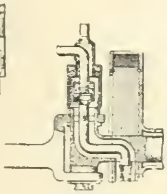
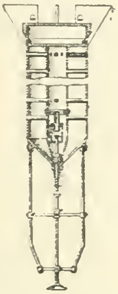

1,242,033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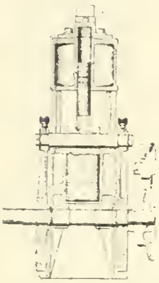
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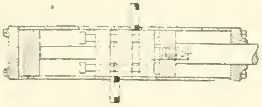
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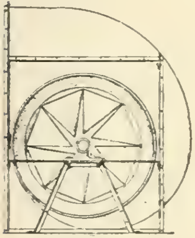
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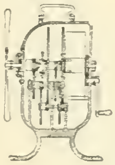
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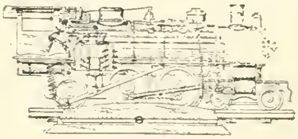

1,241,711

Pneumatic Patents October 2

1,241,725. GREASE-GUN. Howard E. Emigh, Santa Cruz, Cal.

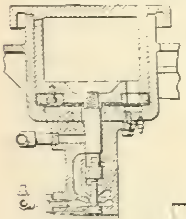
1,241,783. COMPRESSED - AIR VIBRATOR. Charles W. Tocknell, Kenilworth, N. J.

1,241,812. PNEUMATIC CONTROLLER FOR MECHANICAL PIANO-PLAYERS. Harold A. Bierck, Philadelphia, Pa.

1,241,847. DRY VALVE FOR AUTOMATIC SPRINKLER SYSTEMS. John R. Hamilton, Yonkers, N. Y.

1,241,872. AIR-PUMP. Anthony Z. Miciulis, Chicago, Ill.

1,241,959. FOLDING AIR - PUMP. Bennie Goodman, Millican, Oreg.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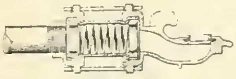
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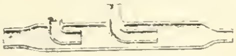
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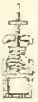
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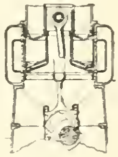
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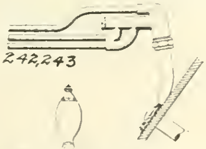
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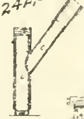
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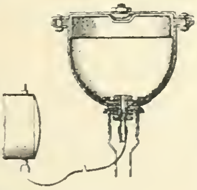
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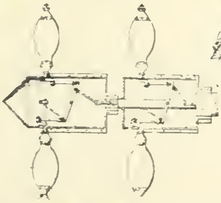
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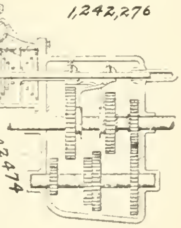
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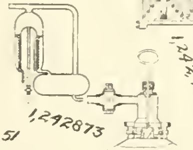
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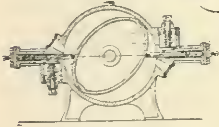

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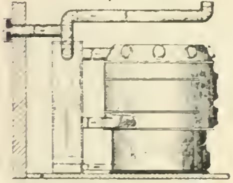

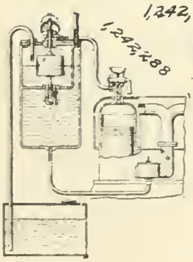
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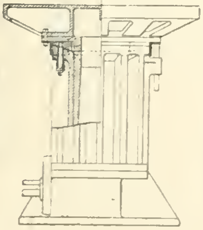
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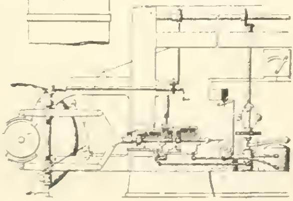
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Pneumatic Patents October 9

1,241,962. FLUID-OPERATED TOOL. Louis W. Greve, Cleveland, Ohio.

1,242,033. FLUID - PRESSURE TRANSMISSION. Albert E. Painter and Waterfield Painter, Reno, Nev.

1,242,040. AIR-COMPRESSOR. William Reaveli, Ipswich, England.

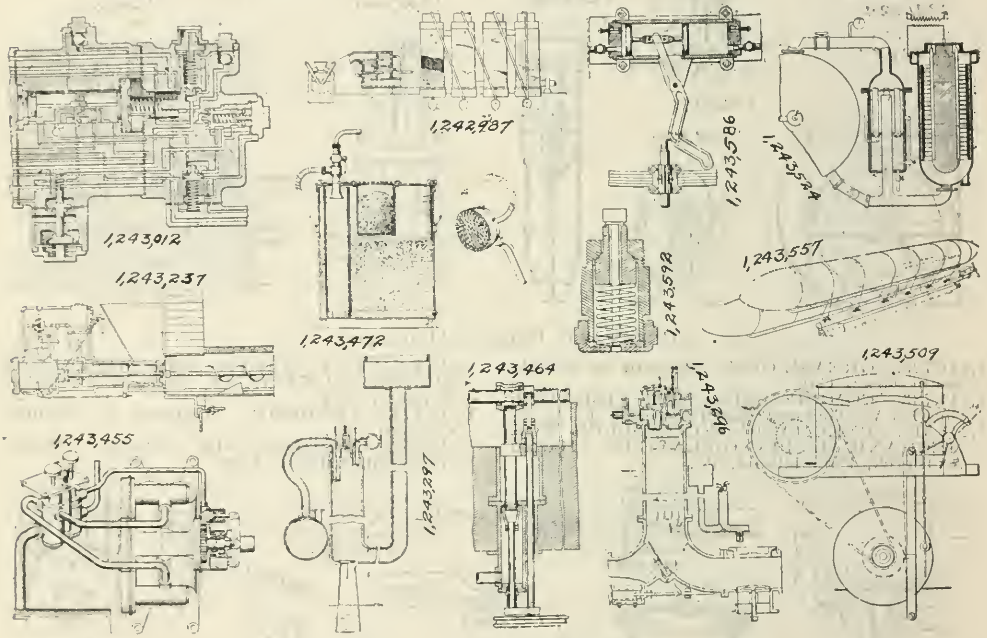
1,242,077. BLOWER. Adolph A. Thommen, Chicago, Ill.

1,242,116. AIR-FAN. John Andrew Sweney, Albuquerque, N. Mex., assignor to Lydia B. Sweney, Albuquerque, N. Mex.

OCTOBER 9.

1,242,183. OIL-BURNER. William G. Hamilton, Cleburne, Tex.

1,242,243. PROCESS OF CUTTING METAL. James R. Rose, Edgeworth, Pa.



Pneumatic Patents October 16

1. The process of cutting metal projections from bodies or plates which consists in directing an oxidizing jet along substantially the plane of junction between the body and the projection and preventing the oxidizing action from extending from the cutting plane in the direction of the body or plate.

1,242,276. COMPRESSOR. William Everett Ver Planck, Erie, Pa.

1,242,287. FUEL - FEEDING APPARATUS. Frederick Weinberg, Detroit, Mich.

1,242,288. VACUUM-FEED SYSTEM. Frederick Weinberg, Detroit, Mich.

1,242,351. JOLT RAMMING-MACHINE. Edward Melville Huggins, New York, N. Y.

1,242,364. COMBINED SQUEEZE AND JOLT RAMMING MACHINE. Thomas J. Mumford, 2d, Plainfield, N. J.

1,242,431. PNEUMATIC SPRING. Ernest D. Foster, Los Angeles, Cal.

1,242,445. APPARATUS FOR TREATING LIQUIDS WITH GASES. Martin H. Ittner, Jersey City, N. J.

1,242,474. PNEUMATIC TRANSMISSION-OPERATING DEVICE. George M. Riley, Aurora, Ill.

1,242,507. VENTLIATING AND HEATING APPARATUS. Erastus W. Woods, Chicago, Ill.

1,242,638. AUTOMATIC TENSION DEVICE AND BRAKE FOR WEB-ROLLS. Howard M. Barber, Stonington, Conn.

1,242,692. ROTARY AIR-COMPRESSOR. Philip D. Hibner, Seattle, Wash.

1,242,788. AIR-PROPELLER. Tony Francisco, South Cle Elum, Wash.

1,242,839. AUXILIARY AIR-VALVE. John J. B. Mulderig, Wilkes-Barre, Pa.

1,242,840. VACUUM BEAN-PICKER. Colton D. Naramor, Caro, Mich.

1,242,870. PNEUMATIC TOY. William Walter Rutter, Edmonton, Alberta, Canada.

1,242,873. PROCESS AND APPARATUS FOR FILLING VESSELS WITH MILK. Wilhelm Gotthilf Schroder, Lubeck, Germany.

1. A process of making durable milk characterized by the fact that the milk, after being pasteurized or homogenized is then passed through a surface cooler within a chamber under a vacuum until the vapor developing in the milk is sucked off, whereupon the milk still being under action of the vacuum is guided into a chamber also under a vacuum, and from said chamber is allowed to flow into the vessel of conveyance or milk can, in which it is closed tight.

1,242,874. TRAIN-PIPE HOSE. James S. Sheafe, New Brighton, N. Y., and Victor Tobolla, Chicago, Ill.

OCTOBER 16.

1,242,987-8. PROCESS OF OXIDIZING GASES. Frank C. Schmitz, New York, N. Y.

1,243,012. FLUID-PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,243,093. FLOATATION APPARATUS. Henry O. Norvell, Mascot, Tenn.

1. In combination, an elongated tank having agitator, having a discharging portion depending froth overflows at opposite ends, an aerating slightly below the liquid level in the tank and having outlets adapted to discharge strata of aerated pulp in the directions of the froth overflows, the tank being substantially unobstructed below the agitator and having a settling space below the same extending throughout the length of the tank, substantially as described.

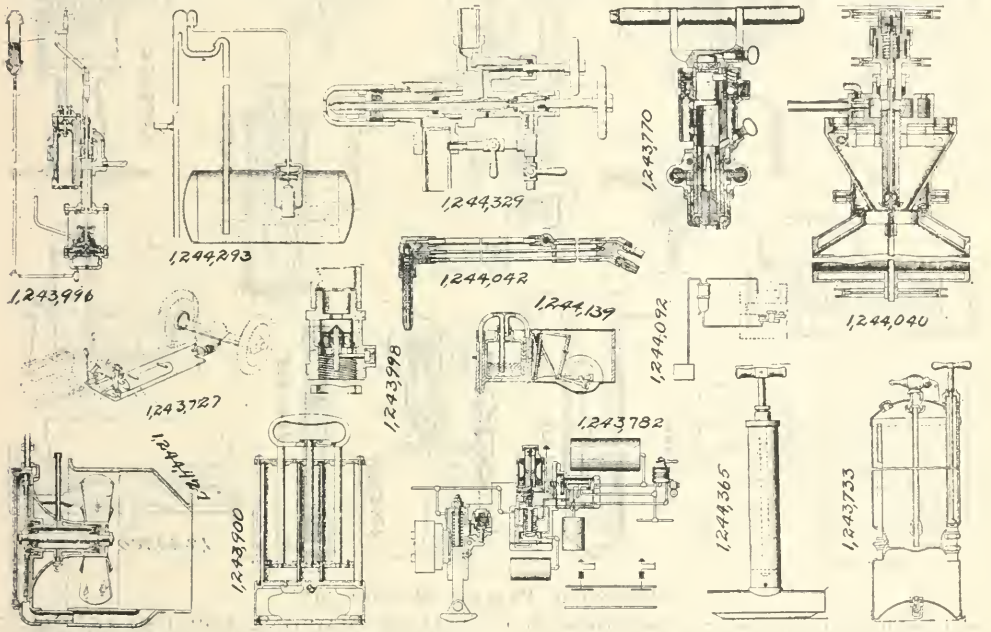
1,243,237. CONTROLLING - VALVE MECHANISM FOR FURNACE-STOKERS. George W. Wood, Camden, N. J.

1. The combination with a plurality of stokers, each having independently operative fuel actuating means, of a valve casing having a plurality of distributing passages therein respectively connected to said actuating means, a valve having a port successively movable into register with said passages, means for supplying pressure fluid to said valve and to successively enter said passages through the port when the valve is actuated, and means for actuating said valve, substantially as described.

1,243,296. UTILIZING AN EXPANSIVE FORCE. Herbert Alfred Humphrey, Westminster, London, England.

1,243,297. METHOD OF RAISING AND FORCING LIQUIDS. Herbert Alfred Humphrey, Westminster, London, England.

1,243,455. STARTING MECHANISM FOR INTERNAL-COMBUSTION ENGINES. Gregory John Spohrer, East Orange, N. J.



PNEUMATIC PATENTS OCTOBER 23

1,243,464. BLOWER FOR BOILERS. Glenn W. Watson, Detroit, Mich.

1,243,472. CLEANING APPARATUS. John MacNaull Wilson, Montclair, N. J.

1,243,509. MEANS FOR CONTROLLING THE OPERATION OF AIR-GAS PLANTS. John Thomas Graham, Halstead, England.

1,243,524. METHOD AND APPARATUS FOR TREATING AIR. William T. Hoofnagle, Glen Ridge, N. J.

1,243,557. AIR-PRESSURE - MAINTENANCE CHAMBER FOR AIRCRAFT. John J. Reynolds, Rantoul, Ill.

1,243,586. MECHANISM FOR OPERATING AIR - COMPRESSORS, Etc. Ira Ellsworth Brown, Fort Stockton, Tex.

1,243,592. PRESSURE AND VACUUM RELIEF VALVE. David Craig, Peabody, Mass.

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1,243,727. AIR-BRAKE SYSTEM. William J. Fried, Fountain City, Wis.

1,243,733. FIRE-EXTINGUISHER. Benjamin M. Grieffith, Pittsburgh, Pa.

1. A portable fire extinguisher consisting of a tank provided with two chambers arranged one above the other with the uppermost chamber adapted to contain a fire extinguishing fluid and the lowermost chamber adapted to contain air under pressure, the tank formed between its ends with an external indentation, a discharge tube for the fluid chamber open to the lower portion of the latter, an air inlet for the air chamber, and a valved tube bridging the indentation and extending from the air chamber to the upper portion of the fluid chamber.

1,243,770. PNEUMATIC TOOL. Mather W. Sherwood, Franklin, Pa.

1,243,782. AUTOMATIC TRAIN CONTROL. Walter V. Turner, Wilkinsburg, Pa.

1,243,900. APPARATUS FOR PRODUCING ARTIFICIAL RESPIRATION. Edmund J. Tyler, Chicago, Ill.

1,243,996. FLUID-PRESSURE REGULATOR. Carl J. Smith, Indiana Harbor, Ind.

1,243,998. FLUID SAFETY-VALVE. Arthur L. Smyly, Chicago, Ill.

1. A heat-operated fluid safety valve comprising a movable valve member held normally in open position by gravity, a spring to close said member in case of emergency only, a locking pin to restrain the spring from acting to close the valve, but permitting closure of the valve by other means, and means having a fusible body to hold said pin in its operative position.

1,244,040. CARBURETER. Micael A. Duz and Dixon E. Washington, Paris, France.

1,244,092. SUCTION - OPERATED LIQUID-FEED DEVICE. Webb Jay, Chicago, Ill.

1,244,139. CARPET-CLEANER. Angel Stathakis, Elizabeth, N. J.

1,244,293. STATIONARY FIRE-EXTINGUISHER SYSTEM. Robert L. Cooney, Atlanta, Ga.

1,244,329. OIL-BURNER. Julius C. Hinz, Detroit, Mich.

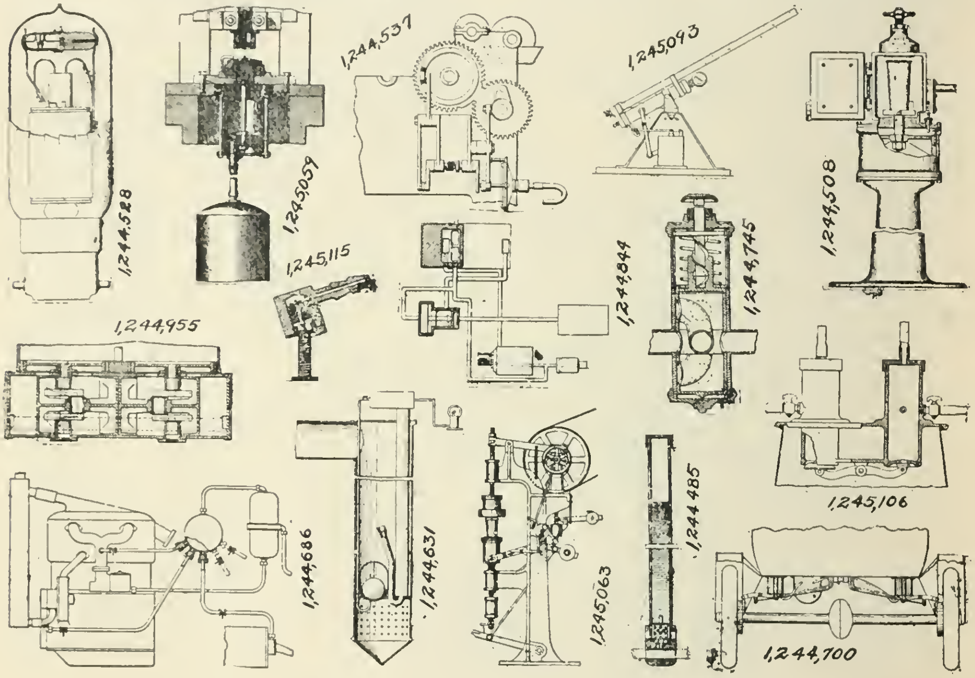
1,244,365. TIRE-PUMP. George H. Patten, Chattanooga, Tenn.

1,244,380. PROCESS OF RECOVERING SALT FROM ITS ADMIXTURE WITH IMPURITIES IN CRUDE BRINE. William W. Skinner and Walter F. Baughman, Washington, D. C.

The process of recovering chlorid of sodium from its admixture with impurities in crude brine, particularly, the salts of barium, consisting of treating brine with sodium sulfate and calcium oxid, pumping air through the mixture thoroughly to incorporate the added substance with the brine and for the purposes of decomposing the ferrous bicarbonate naturally present in the brine, thus producing a flock of iron hydrate, which is carried down with the barium sulfate formed, and crystallizing the pure salt, sodium chlorid, out of the resultant solution, substantially as described.

1,244,427. TURBINE - DRIVEN BLOWER. Frans H. C. Coppus, Worcester, Mass.

1. In a device of the class described, the combination with a turbine, of a blower driven thereby, and having an inclosing casing, and means for delivering the exhaust steam from said turbine into the casing of said blower in a direction corresponding to the movement of air through said casing.



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1,244,485. SOUNDING APPARATUS. Ernst G. Fischer, Washington, D. C.

1. A sounder comprising a tube closed at one end to inclose an air-spring, a cap detachably threaded to the other end of said tube, said cap having a water inlet passage to the interior of the tube, and a valve device, for closing said passage, wholly supported by said cap, said cap having ports for releasing the air while screwing the cap onto the tube.

1,244,508. VACUUM - SEALING MACHINE. Eric B. Kramer, Brooklyn, and Charles Hammer, New York, N. Y.

1,244,528. VACUUM LIGHTNING-ARRESTER. David T. May, New York, N. Y.

1,244,537. PNEUMATICALLY - CONTROLLED BLANK-TRIPPING MECHANISM FOR BLANK-FEEDING MECHANISMS. Melville E. Peters, George H. Fath, and Albert F. Miller, Denver, Colo.

1,244,631. WATER-LIFT. James Americus Mitchell, McCrory, Ark.

1. A water lift including a tubular member provided with an entrance opening, a partition insertible within said tubular member, a pipe secured to said partition and leading from a source of fluid under pressure, said pipe being provided with a returned extension.

1,244,686. VACUUM SYSTEM FOR INTERNAL-COMBUSTION ENGINES. Walter R. Bamford and Harry W. Hamilton, Detroit, Mich.

1,244,700. PNEUMATIC EQUALIZER FOR VEHICLES. John Loucien Chesnutt, Kansas City, Mo.

1,244,745. ROTARY AIR-VALVE FOR CORNETS OR THE LIKE. Eugene E. King, Vancouver, British Columbia, Canada.

1,244,804. STRAIGHT-AIR MECHANISM FOR AIR-BRAKES. Willis C. Webster, Dubois, Pa.

1,244,955. MACHINE FOR USE IN TRANSMITTING ENERGY BY MEANS OF ALTERNATELY-MOVING AIR-COLUMNS. Heinrich Christiansen, Pinneberg, Germany.

1,245,059. DIE-CUSHION. David Strand, Chicago, Ill.

1. The combination of a sheet metal shaping member, means co-operating with said member for shaping the material, and embodying gripping means for the material, a freely detachable and self contained fluid pressure means for maintaining a substantially unvarying pressure on the gripping means during the operation of shaping the material, said fluid pressure means embodying a piston and a cylinder, said piston carrying a rod extending beyond the end of the cylinder and detachably secured to the said shaping member.

1,245,063. VACUUM SEALING - MACHINE. Thomas L. Taliaferro, La Grange, Ill.

1,245,093. PNEUMATIC GUN AND SHELL-FIRING DEVICE THEREFOR. Villeroy Corney Doubleday, London, England.

1,245,106. MILKING-MACHINE. Albert C. Hougland, Madison, Wis.

1,245,115. PNEUMATIC COUPLING. Norman S. McEwen, Nashville, Tenn.

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